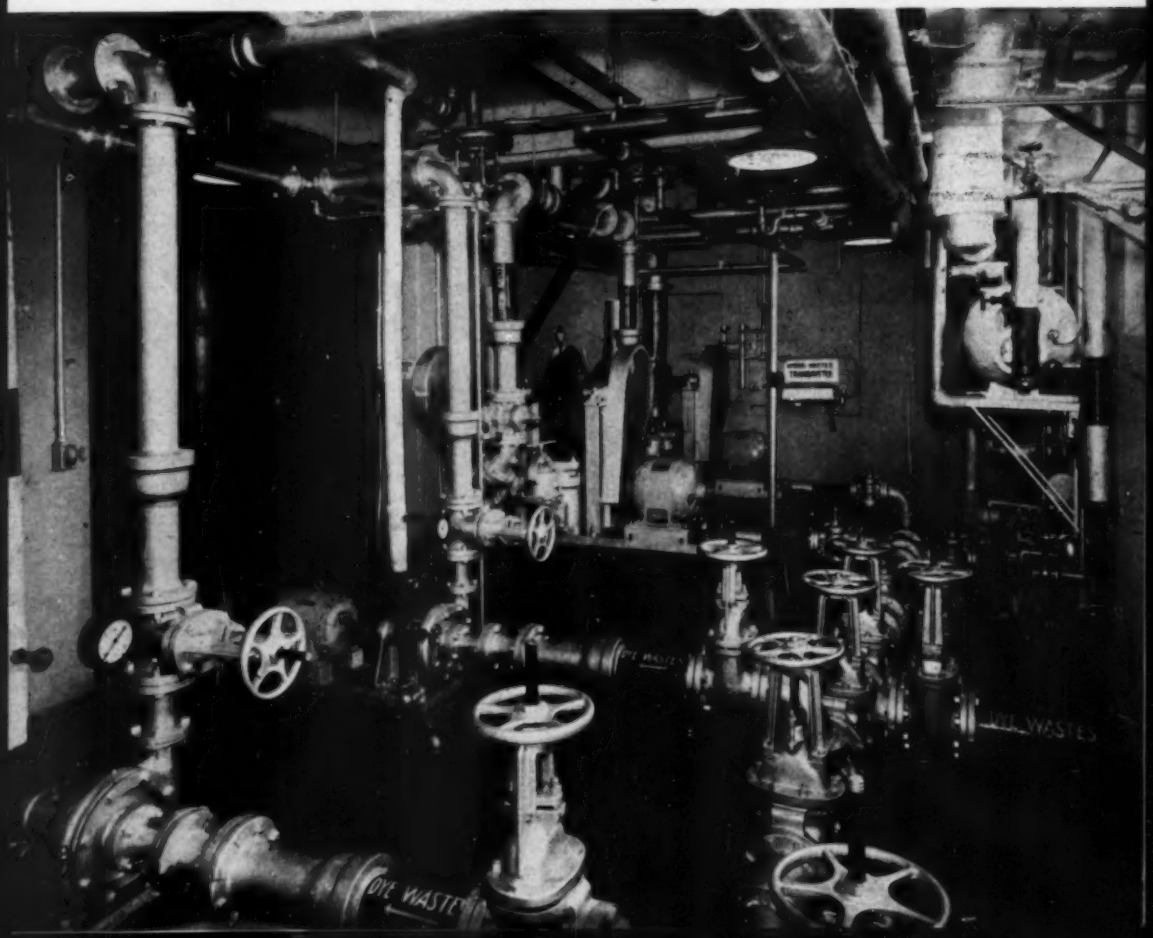
APRIL

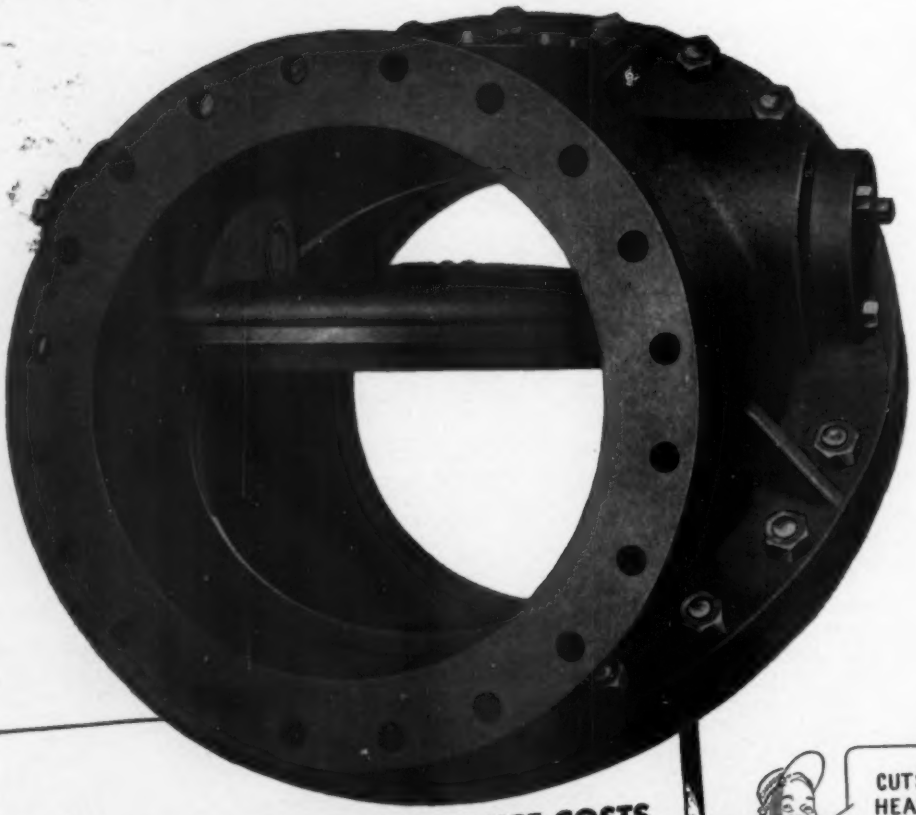
WATER & SEWAGE WORKS

WATER SUPPLY SEWAGE DISPOSAL

INDUSTRIAL WASTE TREATMENT

PUMP ROOM—CARPET MILL WASTE TREATMENT PLANT
James Lees Sons & Co.—Glasgow, Va.





REDUCE PIPE LINE MAINTENANCE COSTS

with CHAPMAN

TILTING DISC

Check Valves

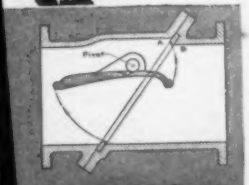
Because of their unique design, Chapman Tilting Disc Check Valves *close without slamming*. There is no water-hammer . . . no vibration of pipe lines or adjacent structure. Nor any danger of opening up pipe joints or rupturing pipe lines. All mighty important reasons why maintenance costs are bound to go down when you standardize on this valve with the cushioned closing.

Yet that's only part of the story. Chapman Check Valves also reduce head losses 65% to 85% over conventional type check valves. And, when installed on pump discharge lines, they not only make possible increased pipe-line capacity but also effect substantial power savings.

Why not send for bulletin with engineering data *today*?

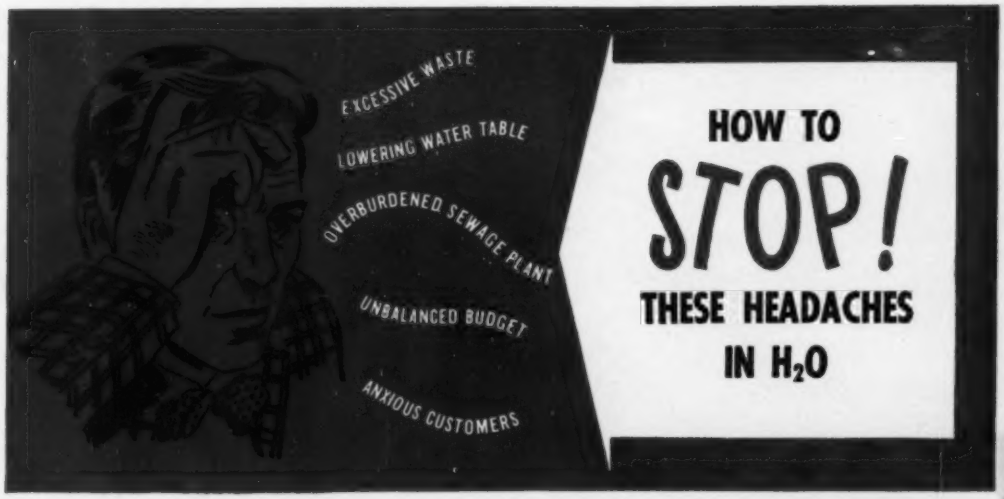
THE CHAPMAN VALVE MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. April, 1950. Volume 97. Number 4. Published monthly by Gillette Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Per copy, 25c; Subscription rate: United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as second class matter March 4, 1948, at the post office at Mount Morris, Illinois, under Act of March 3, 1879. Executive and business offices, 22 W. Maple St., Chicago 10, Illinois. Editorial office, 155 E. 44th St., New York 17, N.Y.



Without a working meter on every service you can't begin to know where a dwindling water supply is going. You can't stop waste. You can't control costs. You can't equitably apportion water charges. You can't even treat sewage economically. In short, without meters you have no control over a service vital to public health and well-being.

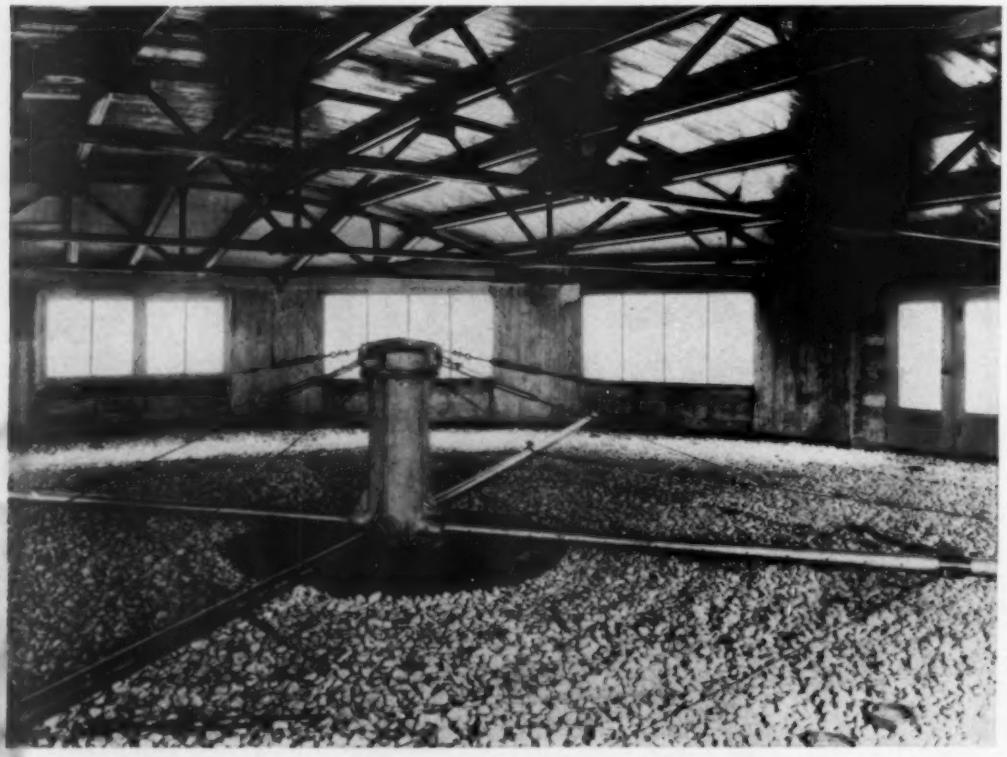
If you are struggling against the odds of an un-metered or only partially metered system, now is the time to do something about it. The nationwide water shortage has made both your consumers and municipal officials thoroughly water conscious. We've prepared a complete program that will help you present the true facts on the advantages resulting from 100 per cent metering in your community. Write today, no obligation involved.

Rx A Pittsburgh Equitable Water Meter on every service!

A TYPE AND SIZE METER FOR EVERY NEED

Pittsburgh Equitable Meter Division
ROCKWELL MANUFACTURING COMPANY
Pittsburgh 8, Pa.

Atlanta Boston Chicago Columbus Houston Kansas City Los Angeles New York Pittsburgh San Francisco Seattle Tulsa



TWENTY-YEAR UPKEEP: ZERO

At the Sunnyside Sanatorium, near Indianapolis, Ind., you can see a rotary distributor that's as new looking as the day it was installed in 1930. The central standard is cast of Alcoa Aluminum. The distributor arms are Alcoa Aluminum Tubing.

Sewage disposal plants throughout the country now reduce maintenance and improve appearance with plant equipment of Alcoa Aluminum. Your builder will be glad to fabricate equipment of light, lasting Alcoa Aluminum. You need only specify Alcoa in your designs. For further information, mail the attached coupon to: ALUMINUM COMPANY OF AMERICA, 2162D Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA

FIRST IN ALUMINUM

Gentlemen:
Please send more information to:

Name_____

Title_____

Company_____

Address_____

WATER & SEWAGE WORKS

WATER SUPPLY—SEWAGE DISPOSAL—INDUSTRIAL WASTE TREATMENT

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

COMING!

Statistical Evaluation of Analytical Data

Has not heretofore been done in many instances of stream pollution plant operation studies. This series of articles presents a new tool in the form of statistical analysis for the sanitary engineer to obtain the proper evaluation of data. Written to show how statistical methods can be used by means of graphic solutions, this series of articles may well revolutionize evaluations of analytical data. This series has been prepared by a pioneer in statistical approach—

PROF. C. J. VELZ,
Univ. of Michigan, Ann Arbor, Mich.

Some New Concepts in Sewage Treatment

Are being unfolded in a series of papers reporting on a basic study of the biochemical and physical mechanisms of sewage treatment and of the criteria by which the performance of these mechanisms may be measured and evaluated. These articles introduce a new and simplified approach to the evaluation of plant unit and process efficiency. This series is the contribution of two top flight investigators—

W. W. ECKENFELDER, JR., and JOHN W. HOOD,
Chemist and Sup't., Sewage Treatment Wks., Ridgewood, N.J.

A Small Plant Chemical Elevator

The handling of chemicals at small treatment plants is not usually given the consideration deserved. This article describes an economical elevator which has made a great difference in the ease of handling chemicals and attendant reduction in accident hazards. The story comes from—

HOWARD J. SOWDEN, Sup't.,
Water & Light Dept., Fergus Falls, Minn.

Sodium Fluosilicate Trial on Plant Scale

Is the newest development in water fluoridation at Sheboygan, Wisc. Here the fluosilicate will appreciably reduce the cost and the results of the trial will be reported by—

JEROME ZUFELT, Supt.,
Bd. of Water Comm., Sheboygan, Wis.

Underground Pollution Abatement

The matter of underground water pollution by industrial wastes has become a subject of increasing attention, especially in Southern California. The City of Los Angeles is enforcing regulations prohibiting the discharge of industrial wastes in any manner wherein such wastes can reach the groundwater reservoir. The success of this undertaking by the Sewer Maintenance Division of Los Angeles, with particular reference to a new development in oil-water separation, is to be related by—

JOHN H. ASHLEY,
Industrial Waste Eng'r., Los Angeles.

A Sensitive Turbidimeter

Is a "home-made" instrument which functions on the photoelectric principle and thus precludes the personal equation as well as turbidity standards in determination of turbidity in filter effluents for the purpose of evaluating filter efficiencies. The inventor of this sensitive and reliable turbidimeter is—

D. H. MATHESON,
Supt. of Filtration, Hamilton, Ontario.

"Doc" Symons—Managing Editor

The Editor takes pleasure in announcing the appointment of Dr. Geo. E. Symons to the position of Managing Editor of *Water and Sewage Works*, beginning with this issue. Although carrying the title Associate Editor, "Doc" Symons has to an increasing degree been performing many of the duties of Managing Editor in a praiseworthy manner.—L. H. E.

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VOL. 97, NO. 4 — APRIL, 1950

CONTENTS

The Sludge Blanket Clarifier 143
By Frank D. Prager
Chicago, Illinois

Headaches, Hunches and Hard Work (II) 153
By M'Kean Maflitt
Wilmington, N.C.

Mobile Lightweight Service Trencher 155
By H. E. Lordley
Richmond, Virginia

Fundamentals of Corrosion and Its Mitigation (III) ... 157
By E. W. Moore, W. H. Sears and L. Rubin
N.E.W.W.A. Committee on Corrosion

Honolulu's Water Supply 161

Operation and Maintenance of Water Wells 163
By E. W. Benulson
St. Paul, Minn.

Modern Wastes Treatment Plant 167
By Stuart E. Coburn
Boston, Mass.

Determination of Metals in Industrial Wastes 172
Part II—Chromium, Vanadium and Cyanide
By H. Gladys Swope, Betty Hattman and Catherine Pollkofer
Pittsburgh, Pa.

Pilot Plant Tests on High Rate Biological Oxidation of Sewage 175
By A. A. Kalinske
Indico Inc.

B.O.D. or C.O.D.—A Commentary 179
By George A. Rhame
So. Car. State Board of Health

Special Tools for Special Work 181
By Reuben F. Brown
Los Angeles, Calif.

On Writing Specifications 182

Meetings Schedule 80A

"Here and There" with Doc Symons 82A

Manufacturers' and Equipment News 88A

Literature and Catalog Reviews 97A

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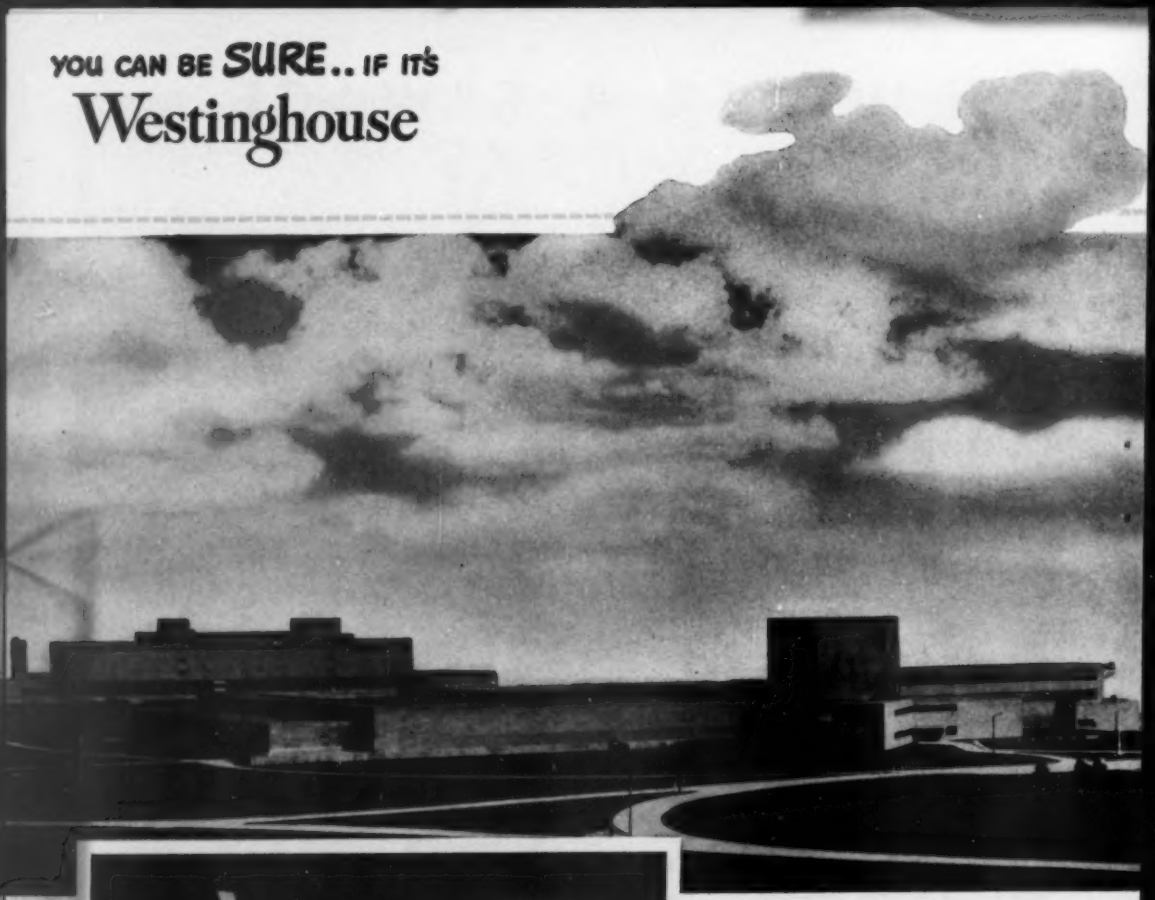
YOU CAN BE **SURE**.. IF IT'S

Westinghouse



The Chicago South District Filtration Plant shown here is the largest in the world, serving more than a million and a half people. The plant has operated at an hourly peak of 546 mgd with only 70 of the 80 filters in service.

This mezzanine switchgear room in the lower left pumping station is an example of the way Westinghouse designs and manufactures electrical equipment for a co-ordinated, efficient system. (Right) High-voltage switchgear gives necessary protection on incoming lines, as well as feeders, and supplies power to large pump motors and station transformers. (Left) Low-voltage switchgear controls station auxiliaries such as priming pumps, crane motor feeder and valves. (Rear center) Network protectors and 120/208-volt distribution for building lighting and miscellaneous power. (Front center) Control desk with mimic bus, indicating instruments and circuit breaker switches centralizes control of plant equipment.

Westinghouse

EQUIPMENT
FOR PUBLIC WORKS

Unit Responsibility

ASSURES WATER WORKS EFFICIENCY

For any water works, large or small, higher operating efficiency depends in part on your electrical manufacturer.

He should provide every type of electrical equipment . . . give you a co-ordinated engineering application . . . based on practical experience in water works electrification.

These elements add up to unit responsibility and mean reduced operating costs for your plant. You get them all from Westinghouse:

Westinghouse makes a complete line of electrical equipment for water works. This includes "Unitized" metal-clad switchgear; packaged power centers, power transformers and unit substations; control and control centers; motors and gearmotors, as well as other electrical apparatus and supplies.

Westinghouse Consulting and Application Engineers are available to work with you. They will help you select and apply the right equipment to give you a co-ordinated, efficient electrical system.

Westinghouse brings you a background of long experience in applying electrical equipment to water works. The Chicago South District Filtration Plant, shown here, is but one more in a large list of outstanding installations where Westinghouse unit responsibility has been *proved* on the job.

For help on your water works electrification problems, call your nearest Westinghouse District Office, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-94818

This control center on the third floor of the Chemical Building groups into one unit all the combination linestarters and motor control for fan motors, agitator drives and other auxiliary equipment in this plant area.

These two 300-kva, 3-phase, 60-cycle, 2300/120-208-volt, liquid-filled distribution transformers are located in the west pump room and supply power for the building lights and equipment in the Filtration Plant.

SODIUM BIFLUORIDE

SODIUM FLUORIDE

RIMMED STEEL: Added in pouring billets to insure a smooth rolled sheet.

LAUNDRIES: As a "sour" to neutralize excesses of soap and other alkaline detergents; to remove iron stains.

WATER TREATMENT: For fluoridation of public water supplies.

How Do These GENERAL CHEMICAL FLUORIDES Fit Into Your Operation?

GLASS: As an etching and frosting agent.

PEST CONTROL: For extermination of vermin.

BASIC CHEMICALS

GC

FOR AMERICAN INDUSTRY

LEATHER: For treating infected hides.

ADHESIVES & STARCHES: In manufacture of glues and liquid starches.

MAINTENANCE: In cleaning stone and brick building exteriors.

HEAT TREATING: Ingredient of salts.

STAINLESS STEEL: As a Hydrofluoric Acid substitute in pickling baths.

WOOD PRESERVATIVE: To prevent insect attack on structural and other materials.

THE WIDE VERSATILITY of General Chemical Sodium Fluorides enables them to play important and varied roles: from the manufacture of rimmed steel, to the treatment of public water supplies . . . from pest extermination, to commercial laundry work. Their chemical and physical properties indicate they may offer advantages worth investigating for many other operations too.

FOR DETAILED information on the quality and characteristics of these products, or for expert Technical Service in determining their potentialities for *your* operations . . . contact the nearest General Chemical office listed below.

General Chemical Sodium Fluoride and Sodium Bifluoride are available in the following strengths and densities: Sodium Fluoride, white—light or dense, 90% and 95% NaF, also Nile Blue—light, 95% NaF; Sodium Bifluoride, powdered, 90% $NaHF_2$.

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION

40 Rector Street, New York 6, N. Y.

Offices: Albany • Atlanta • Baltimore • Birmingham • Boston • Bridgeport • Buffalo • Charlotte Chicago • Cleveland • Denver • Detroit • Houston • Los Angeles • Minneapolis • New York Philadelphia • Pittsburgh • Portland (Ore.) • Providence • San Francisco • Seattle • St. Louis Wenatchee and Yakima (Wash.)

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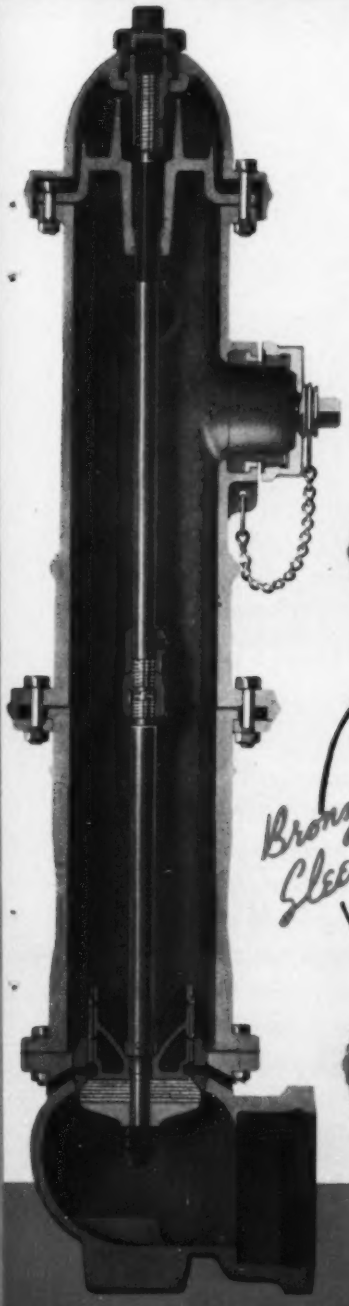
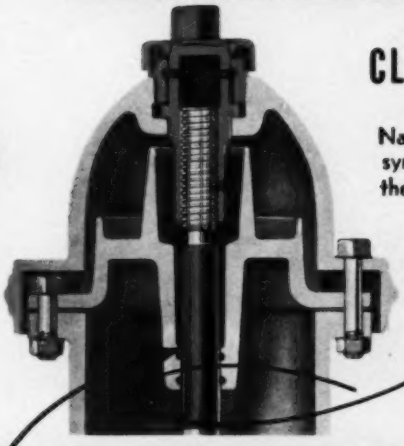
THE MUELLER HYDRANT has The "O" RING SEAL...



No Stuffing Box to require adjustment . . .
No Packing to dry out and leak . . .
No Stuffing Box Bolts to corrode or break . . .
No Stuffing Box Gland to bind the stem . . .
Threads and Bearing Surfaces fully bronze mounted and self lubricated.
Bronze Weather Cap prevents freezing or unauthorized removal of operating nut.

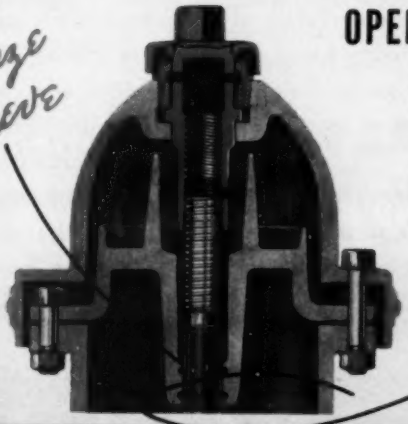
DEPENDABLE — EASY TURNING IN SUMMER OR WINTER



CLOSED -NO PRESSURE

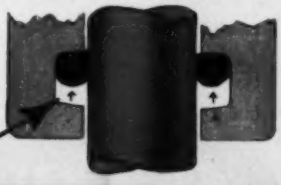
Natural resilience of the compressed synthetic rubber "O" Ring provides the sealing force.

Bronze Sleeve



OPEN -UNDER PRESSURE

The "O" Ring is distorted by being forced to the side of the groove away from the pressure augmenting the sealing force. The greater the pressure, the greater the sealing force.



MUELLER CO.

FACTORY: *Chattanooga, Tenn.* MAIN OFFICE AND FACTORY: *Decatur, Ill.*
OTHER FACTORIES: *Los Angeles, Cal.* • • • • *Sarnia, Ont. Canada*

Without crushing strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada.

Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

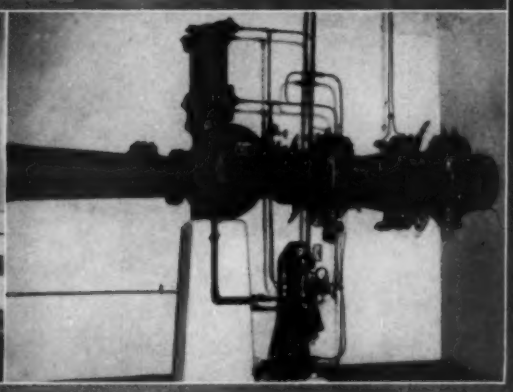
In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SERVES FOR CENTURIES

AMHERST, MASS.

Sewage Treatment Plant

HALEY and WARD
(Successors to F. A. Barbour)
Consulting Engineers
BOSTON, MASS.



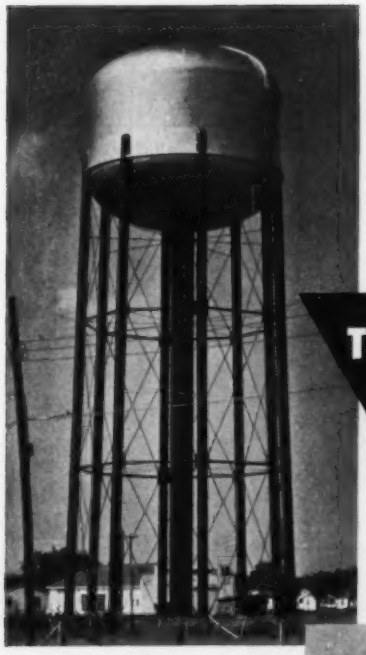
In the engineering of this attractive primary sewage-treatment plant for the Town of Amherst, Haley and Ward (successors to F. A. Barbour), solved the problem of widely fluctuating influent rates. The population served totals about 8,000 persons and includes the enlarged Winter personnel of the University of Massachusetts and Amherst College. Seasonal flow rate varies from 350,000 to a million or more gallons per day. Builders sewage metering equipment, installed by Troy-Mayr and Sons, Inc., measures the flow and automatically operates an adjustable rate controller which keeps the flow to the treatment plant within the design capacity. For Bulletins describing Builders sewage works equipment, address Builders-Providence, Inc., (Division of Builders Iron Foundry), Providence 1, R. I.

Builders equipment furnished for the Amherst Sewage Treatment Plant:

12" x 5" Venturi Tube with Special Accessories for Metering Raw Sewage

Type M Registering-Indicating-Recording Instrument with Diaphragm Control Unit, Air Relays, Compressors and Accessories

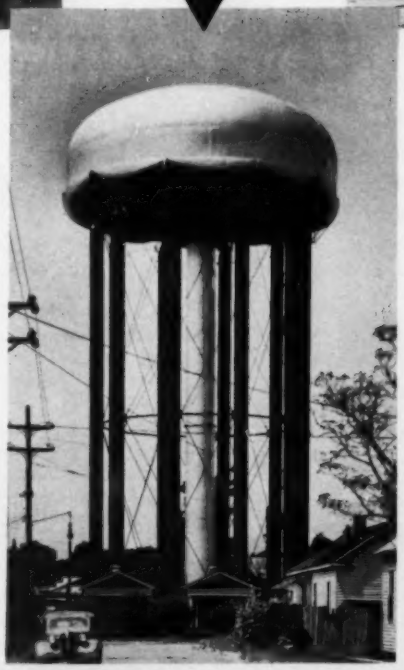
BUILDERS PROVIDENCE
Instruments



The two Horton ellipsoidal-bottom elevated tanks shown in the views at the left and right have a capacity of 500,000 gallons each.

The Horton radial-cone bottom tank shown below has a capacity of 750,000 gallons. It forms parts of the distributed storage "team" at Baton Rouge.

THREE REASONS
for better water service at BATON ROUGE



Water service has been improved in Baton Rouge, Louisiana, because the Baton Rouge Water Works Company took two important steps—it decided upon the use of elevated water tanks for storage and then it wisely "distributed" this storage in various parts of the city. Each area thus benefits from improved service by meeting peak demands with its own water reserve—a reserve that flows into the mains by gravity alone.

Horton elevated tanks are available in capacities from 15,000 to 500,000 gallons in the ellipsoidal-bottom design, and in capacities from 500,000 to 3,000,000 gallons in the radial-cone bottom design. Write our nearest office for information on distributed storage for your community.

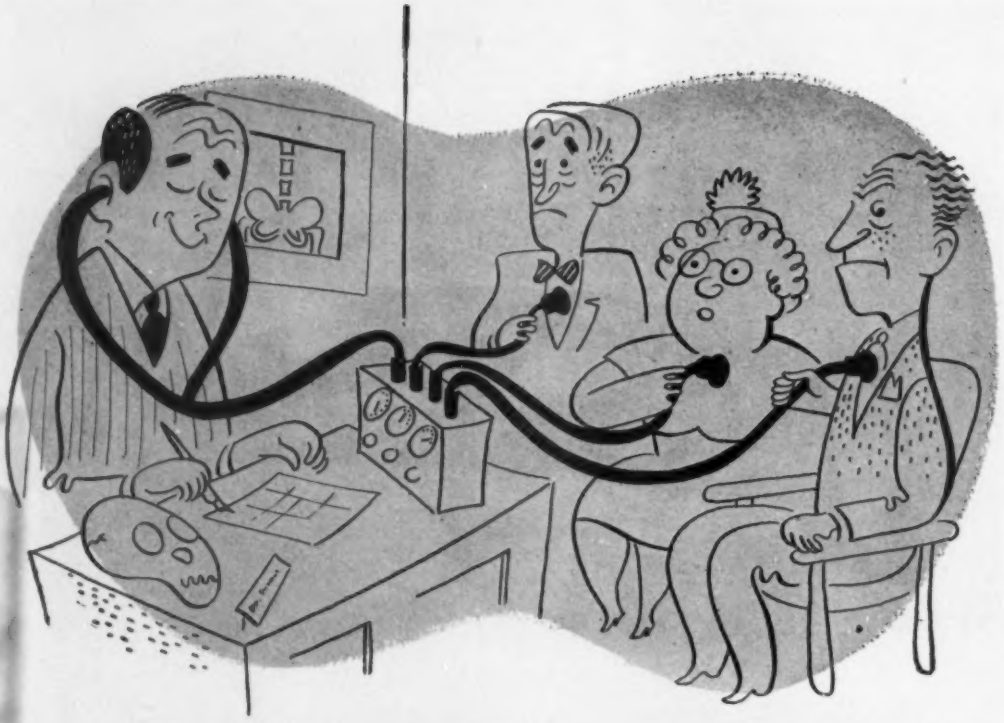
Advantages of Distributed Elevated Water Storage

- Maintains more uniform pressures in the mains throughout water distribution systems.
- More efficient use of pumping equipment because the tanks can be filled during periods of low demand.
- Gives separate sections of the city a local water reserve for fires and other emergencies.
- Reinforces weak sections of the distribution system.
- Generally results in appreciable savings through better insurance ratings.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3.....2181 Healey Building
Birmingham 1.....1586 North Fiftieth Street
Boston 10.....1040—201 Devonshire Street
Chicago 4.....2199 McCormick Building
Cleveland 15.....2262 Guildhall Building
Detroit 26.....1851 Lafayette Building
Houston 2.....2115 National Standard Building
Havana.....402 Abreu Building
Los Angeles 17.....1555 General Petroleum Bldg.
New York 6.....3390—165 Broadway Building
Philadelphia 3.....1644—1700 Walnut Street Building
Salt Lake City 4.....550 West 17th South Street
San Francisco.....1283—22 Battery Street Building
Seattle 1.....1350 Henry Building
Tulsa 3.....1646 Hunt Building

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA



Reduced Treatment Costs

Less load at the disposal plant—and, therefore, a reduction in sewage treatment costs—is one of the practical advantages that often result from the use of Transite® Sewer Pipe.

There are two good reasons for this:

(1) Transite's special sleeve-type joints that cut sewer line infiltration to a minimum.

(2) Transite's long 13-foot lengths that reduce the number of joints in the line—an additional safeguard against infiltration.

Besides the immediate saving in treatment costs, this reduction in load also enables plant capacity to be conserved for future needs. And, where new treatment facilities are planned, it permits consideration of a smaller plant . . . with possible important economies in disposal equipment.

Other Transite Economies . . . Transite has an exceptionally smooth interior that reduces resistance to flow. This, combined with its long lengths that help maintain uniform grades, plus fewer joints that reduce turbulence, often permits designing the system with flatter grades and shallower trenches. Or, as an alternate economy, pipe of smaller diameter may be specified.

Transite Sewer Pipe is made of asbestos, cement and silica by a special method of manufacture which develops high, uniform strength and resistance to corrosion. It is available in four strength classes in sizes to 36". This permits selection of the pipe best suited to trench conditions, frequently eliminates the need for concrete cradles.

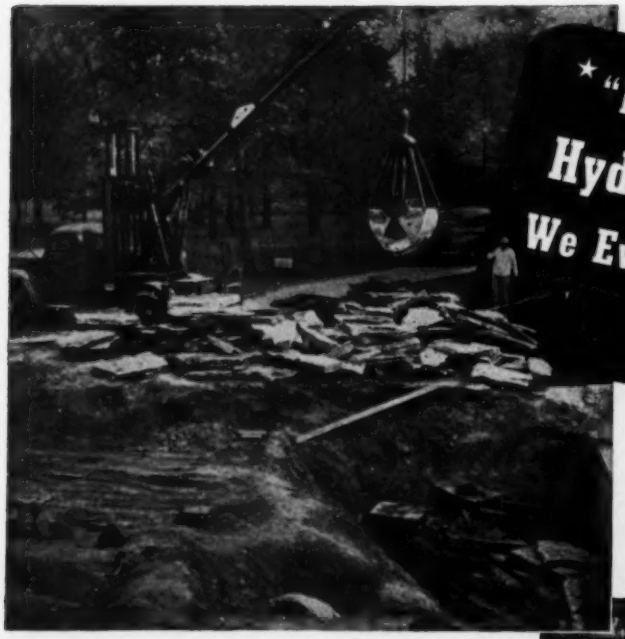
For further details, write Johns-Manville, Box 290, New York 16, N. Y.

JM

®Transite is a Johns-Manville registered trade mark

.....Johns-Manville

TRANSITE SEWER PIPE...



★ "More Uses For Hydrocrane Than We Ever Imagined..."

*Says Milwaukee County Parks User

Here the Hydrocrane sets lannon stone on a waterfall project. The park horiculturist says: "This machine surely does a good job. The Hydrocrane handles stone so smoothly we never worry about chipping or breakage. We've set 1,600 pound rocks and this machine hasn't dropped a single one — that hydraulic bucket really grips 'em. Also it does the work in one-sixth the time we needed with a derrick and hand labor."

"OUR truck mounted Hydrocrane handles more jobs than we ever thought possible," says a spokesman of the Milwaukee County Park Board. "Its high mobility is a big help in covering 6,000 acres of park in 65 scattered locations."

"This rig speeds manhole digging and cuts out the shoring-up needed to protect hand labor. Now if cave-ins occur, the Hydrocrane just takes another scoop. It's tops for small excavating — finishes the work in the time it takes to get a heavy unit to the job. This winter it'll be a big help in snow removal."

Park Board's Hydrocrane a time saver here, too

★ Setting flag poles
★ Grading around buildings
★ Excavating for gas lines
★ Cleaning sunken gardens
★ Trenching
★ Stockpiling material
★ Handling pipe
★ General yard work

Money-saving Hydrocranes are available in two sizes — 2-ton ½ yd., and 3-ton ⅝ yd. One cu. yd. snow bucket available for both 2-ton and 3-ton machines. Send the coupon for full information.

BUCYRUS-ERIE HYDROCRANE DIVISION
South Milwaukee, Wisconsin

BUCYRUS ERIE
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BUCYRUS-ERIE HYDROCRANE DIVISION
South Milwaukee, Wisconsin

Gentlemen: Tell me how the Hydrocrane can speed up my jobs.

Name.....

Company.....

Address.....

City..... State.....

53HD0

MODERN PIPE *for* *Modern Service Requirements*

MODERN USAGE is continually making increasingly severe demands on pipe lines. Underground mains must do much more than merely resist corrosion. They must convey greater volumes, at higher internal pressures; they must withstand vastly increased external loadings; they must be adapted to an ever-widening range of service conditions. Mono-Cast Pipe possesses the exceptional physical strength and uniformity necessary to meet these requirements.

Long service with minimum maintenance, coupled with simplicity in installation, make Mono-Cast Pipe a favorite for systems conveying water, gas, oil, sewage or other liquids under high, medium or low pressures. Supplied with or without tar coating, cement or Enameline lining in sizes 3-inch through 48-inch.

Mono-Cast Pipe serves equally well beneath crowded city streets or in cross country installations. View at right shows a 36-inch Mono-Cast bell and spigot pipe line serving Oklahoma City, Oklahoma.

AMERICAN
CAST IRON PIPE
COMPANY
Birmingham 2, Alabama

WICHITA, KANSAS

Wichita Municipal Water Works

(COMPLETED IN 1948)

BLACK & VEATCH
Engineers

MARTIN K. EBY CONSTR. CO.
Contractors

Over the past decade an extensive system of wells, supply lines, and treatment installations has been developed to provide high-quality water for Wichita, Kansas. The original plant, engineered by Black & Veatch and constructed by Carrothers and Crouch, went into operation on September 1, 1940. Additional facilities, completed in 1948 by Martin K. Eby Construction Company, provide the necessary capacity for present and future population demands.

Omega Lime Feeding and Slaking equipment, installed in the new extension, operates in response to the actual flow of water through the plant. A Builders Chronoflo Transmitter automatically paces the Omega equipment, thus helping Robert H. Hess, Chief Chemist and Superintendent, to reduce hardness and maintain uniform palatability of the final effluent. For Bulletins describing Omega water works equipment, address Omega Machine Co. (Division of Builders Iron Foundry), Providence 1, R. I.

Omega water works equipment furnished for the Wichita Municipal Water Works:

1 — Model 44-20 Belt-type Gravimetric Feeder

1 — 1100 lbs. per hour Lime Slaker

1 — Builders Chronoflo Transmitter for flow proportional control

1 — Builders Chronoflo Instrument for remote recording

THE LAST WORD IN FEEDERS

OMEGA

acids can't affect CLAY PIPE

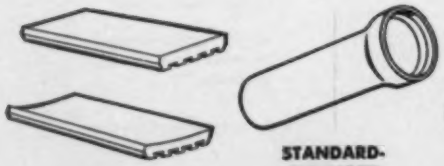
VITRIFIED CLAY PIPE provides the only *sure* protection against costly, dangerous acid attack. "Inside and out," it's chemically inert — absolutely immune to corrosion, rust, or decomposition. In a recent survey of 122 leading American cities, it was found that 89% of the existing sewers are Vitrified Clay Pipe lines. *And there is not one instance on record of a single length of Clay Pipe wearing out due to acid attack.* It pays to play safe . . . to guard against the dangerous acids and alkalies found in sewage and ground waters. Be *sure* by specifying Vitrified Clay Pipe — the *only* pipe that never wears out.

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1105 Huntington Bank Bldg., Columbus 15, Ohio
703 Ninth and Hill Bldg., Los Angeles 15, Calif.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
206 Connally Bldg., Atlanta 3, Ga.

SPECIFY

Vitrified

CLAY PIPE



LINER PLATES

STANDARD-STRENGTH CLAY PIPE

CLAY PIPE FITTINGS

C-750-2

FOR EVERY STEP OF YOUR SEWAGE TREATMENT PROCESS

WHEN you specify INFILCO Sewage Treatment Equipment, you get more than just equipment. Actually, you specify over 50 years experience in the design and manufacture of a *complete range* of water, sewage and waste treatment equipment.

You have *one source* to depend upon for experience in both chemical and biological treatment . . for the major equipment items as well as the important control devices. And by providing a *complete range* of sewage treatment equipment INFILCO offers the all-important advantage of *undivided responsibility!*

A complete laboratory and staff of competent engineers are available for making recommendations and reports to the consulting engineer or his client. It is, of course, intended that this service shall cooperate with the work of your engineers. When considering your next sewage treatment plant, or the modernization of an existing one, consult your Telephone Red Book. Call in your nearest INFILCO Field Engineer!

SEND FOR . .

Bulletin No. 60-C. It illustrates and describes many items of Infilco Equipment.

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

INFILCO INC.

GENERAL OFFICES: 325 WEST [illegible] CHICAGO 16, ILLINOIS

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

It's up to 25 times more "Non-Clog"!

Here . . . now . . . is an amazing development in sewage and trash pumps . . . the Fairbanks-Morse *Bladeless* Impeller Pump.

In actual tests and field operation, it is from 10 to 25 times more "non-clog" than any conventional sewage and trash pump. It gives you improved efficiency in pumping water containing solids and trashy materials. It gives you a new conception of low maintenance cost. This pump rarely has to be dismantled to clear "clogged" impellers. Contrast this to the ordinary pump where dismantling is required as much as several times daily.

Another important advantage is the fact that for a specific solids size, the pump delivers approximately one-half the capacity of conventional sewage pumps. Thus you do not flood filter beds in plants where sewage flows are relatively low. Reduced capacity permits the use of smaller driving motors, thus assuring economical initial costs . . . lower power costs.

For complete details, check your Fairbanks-Morse Pump Distributor, local branch office, or write Fairbanks, Morse & Co., Chicago 5, Ill.

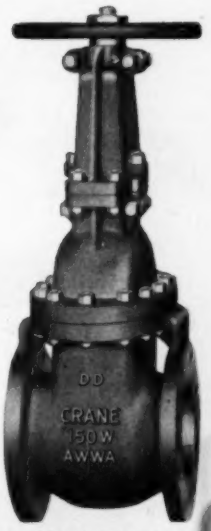
Eliminating blades, this impeller is a helical channel . . . a "whirling tube" with no blades to catch and hold fibrous trash and cause the pump to clog.

FAIRBANKS-MORSE,

a name worth remembering

Diesel Locomotives and Engines • Electrical Machinery • Pumps • Scales
Home Water Service and Heating Equipment • Rail Cars • Farm Machinery

Piping for every water service
From one Source . . . CRANE



No. 2495, Outside screw and yoke. Cold Water Working Pressures: 12-inch and smaller, 200 pounds. 14-inch and larger, 150 pounds. Sizes: 2 to 24-inch.

FOR TIGHT SEATING . . . EASY OPENING

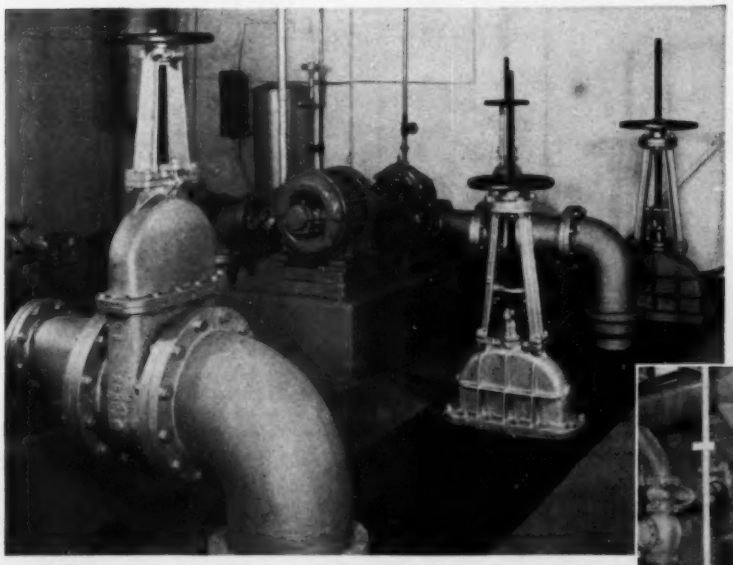
Crane A.W.W.A. Iron Body Gate Valves cannot be surpassed. Crane parallel seat and double disc construction assures pressure-tight closure . . . easy opening . . . under all operating conditions. To prevent corrosion, screwed-in body seat rings are brass; discs are brass or brass faced.

Crane design assures maximum strength for all recommended services. Body and bonnet are oval shaped, with uniformly thick metal sections; tie ribs between bonnet flange and end flanges assure proper body support and guard against line strains.

Straight-through ports give uninterrupted flow. Two-piece gland maintains uniform pressure on packing; prevents binding on stem; lengthens packing life. These valves can be motor or cylinder operated; equipped with gears and by-pass. Flanged and hub ends available. See your No. 49 Crane Catalog.

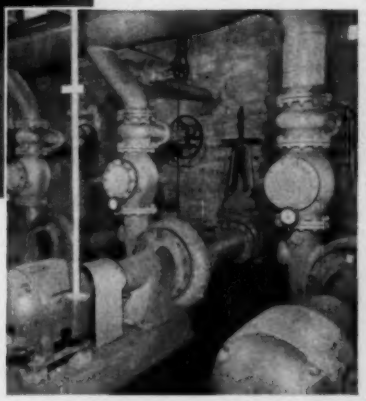
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE ORDER TO CRANE COVERS ALL MATERIALS FOR YOUR PIPING INSTALLATIONS



RAW WATER INLET *lines to high service pumps, featuring Crane low pressure iron body double disc gate valves.*

PUMP HOUSE *for moving industrial waste water to treating plant. Crane equipment includes shop fabricated manifold, iron body gate and check valves.*



EVERYTHING FOR EVERY PIPING SYSTEM

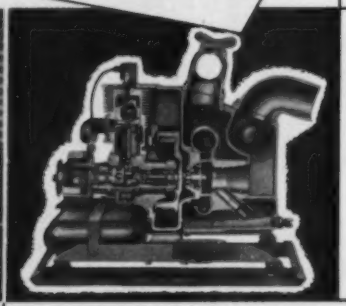
CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

FOR 3 BIG REASONS

A HOMELITE CARRYABLE PUMP IS THE PUMP TO HAVE ON THE JOB

1. PERFORMANCE. Just add it all up . . . lightweight for easy handling, 15,000 gallons per hour, the fastest self-priming possible, a guaranteed 28 ft. suction lift, automatic seepage control, no trouble with clogging even when *handling mud and solids* . . . that's what you always get from a Homelite *carryable* gasoline-engine-driven pump that can be set up for operation easily and quickly *anywhere*.



2. DEPENDABILITY . . . continuous trouble-free performance . . . is the result of all the special features that Homelite engineers build into their pumps . . . replaceable abrasive-resistant wear plates, a simple five-part sealing device and impeller that require no grease, packing or attention and a non-clogging pump body directly attached with no bearings necessary, to the famous Homelite Gasoline Engine, the result of building over 275,000 gasoline-engine-driven units this past quarter century.

3. SERVICE. To keep Homelite pumps operating continuously, just as the day they were first delivered, a chain of exclusive Homelite service shops extend across the nation. These service stations are completely stocked and staffed by trained Homelite men who are ready to keep your Homelite pumps in top notch condition at all times.

STICK TO THE RULE OF THREE 1. Performance 2. Dependability 3. Service, and you'll always stick to a Homelite.

DEPENDABILITY · PERFORMANCE · SERVICE

Homelite Corporation

704 RIVERDALE AVENUE, PORT CHESTER, NEW YORK

Saved!

...Hundreds of Man-Hours on New Installations

YOU

CAN NOW DO AN ALL
MECHANICAL-JOINT JOB
WITH
PIPE, FITTINGS, VALVES AND
HYDRANTS

...with EDDY Mechanical-Joint Valves

After excavation, two unskilled workmen and a ratchet wrench can install Eddy Mechanical-Joint Valves in a jiffy. This can mean many man-hours saved each year. What's more, the work can be done in a flooded trench, or in any kind of weather—for no caulking, no lead-melting is needed . . . and all joints are *bottle-tight* under pressure. Valves meet AWWA specifications, and are available in sizes 3" to 12" for use on both sand-cast and centrifugally-cast iron water pipe.

...and EDDY Mechanical-Joint Fire Hydrants

Since 1849 EDDY For Long Service

Mechanical-Joint connection allows quick, easy installation or removal (with or without auxiliary valve). Hydrants also available with bell or flanged connection. All operating parts accessible by removing top cover. Hydrants open fast, close easily. Even a bent stem does not cause water loss, and drip-action prevents freeze-up. Stock up now on both Clow Mechanical-Joint Cutting-in Valves and Hydrants. Be ready to make easy, speedy installations when needed!

EDDY VALVE COMPANY

WATERFORD NEW YORK

A Subsidiary of James B. Clow & Sons

for primary and secondary settling tanks

Jeffrey Collectors—designed for rectangular shaped settling tanks — simplest and most efficient type of sedimentation device.

Large Carrying Capacity — permits intermittent operation.

Stable Conditions of Flow—resulting from proper baffling of influent and correct location of effluent troughs.

Considerable Power Saving—one-half revolution of conveyor once or twice daily sufficient to remove all settled sludge — thicker sludge and clearer effluent.

Positive Movement of Scum — to effluent end of tank for removal by Scum Removers.

These Collectors — for small, medium or large tanks—have been installed in many plants—all same general, well-proved design. Besides we make Bar Screens, Grit Washers and Collectors, Scum Removers, Chemical Feeders, Grinders, Sludge Elevators, Flocculation Equipment, etc.

A competent Sanitary Engineer, well versed in the treatment of water and sewage by mechanical means, will be glad to make recommendations.

JEFFREY

ESTABLISHED 1877

JM

SALES OFFICES IN PRINCIPAL CITIES

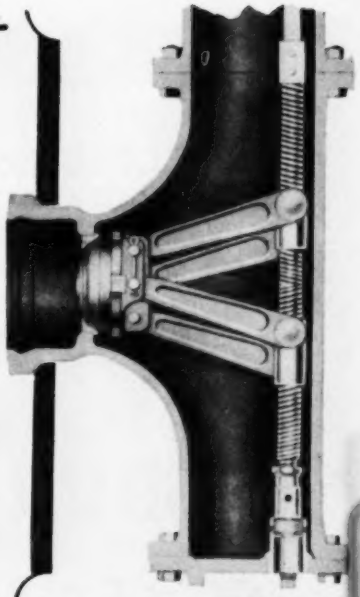
THE JEFFREY MANUFACTURING COMPANY 996 NORTH FOURTH STREET, COLUMBUS, OHIO

No Sir.... that

RENSSELAER MAIN VALVE

can't open by barrel breakage

IT'S MECHANICALLY LOCKED SHUT



HERE'S another feature of the famous Rensselaer Hydrant — NO FLOODING if barrel is broken. The main valve is MECHANICALLY LOCKED shut by steel forgings bearing solidly against the case. Hard rubber valve seats stay tight — won't leak or scar. This Hydrant can't open unless the stem is rotated — and since it opens with the pressure, it opens EASILY and quickly.

What's more, if the standpipe is broken off, the ground line flange makes replacement quick and easy — no pavement breaking, no digging.

Yes, this Rensselaer Hydrant is a first-class investment. All working parts lift out easily, quickly. No water hammer. Drains fast without clogging. Solid bronze gives long life to vital parts. In short, SOUND DESIGN, a sound buy, proven by thousands in service making good the Rensselaer reputation. See a Rensselaer Representative for details — just call our nearest office.

THE FAMOUS RENSSELAER COREY HYDRANT

See how....

THE FLANGE AT GROUND LINE ELIMINATES DIGGING UP

7

LEADERSHIP FOR OVER 65 YEARS

RENSSELAER VALVE COMPANY

Hydrants • Gate Valves • Square Bottom Valves
Check Valves • Tapping Sleeves and Valves • Air Release Valves

TROY, NEW YORK

Division of Neptune Meter Company

Atlanta, Bala-Cynwyd, Pa., Chicago, Dallas, Denver, Haverhill, Mass., Hornell, N. Y., Kansas City, Los Angeles, Memphis, Pittsburgh, San Francisco, Seattle.

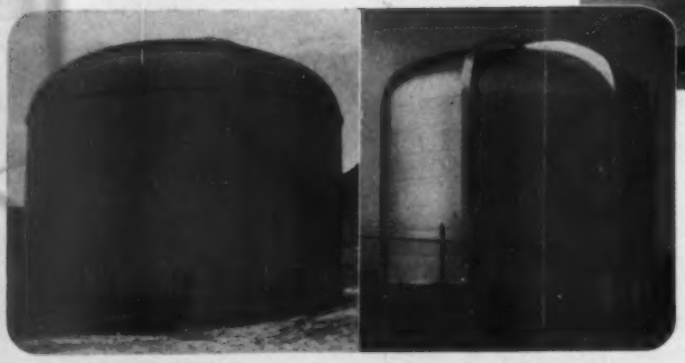
FOR ECONOMICAL

Water Storage

AT NATURAL ELEVATIONS

PITTSBURGH-DES MOI

Standpipes and Reservoirs



Sound, enduring performance, based on correct engineering, dependable fabrication and careful erection, assures complete satisfaction with Pittsburgh-Des Moines Steel Standpipes and Reservoirs.

Over the years, their first-cost economy, low maintenance, and continued freedom from deterioration make these units an ideal water storage investment. *Write!*

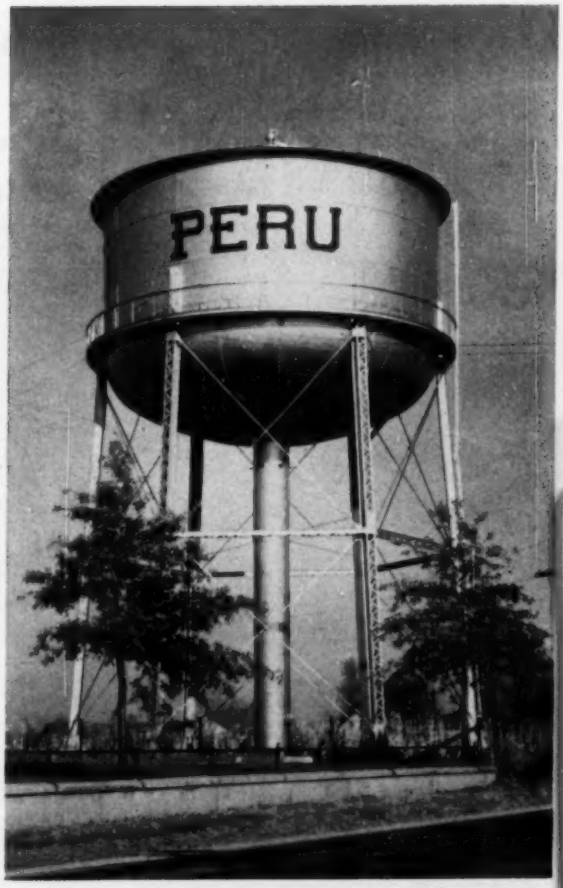
PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH . . . 3418 Neville Island
NEW YORK . . . Room 918, 270 Broadway
CHICAGO, 1222 First National Bank Bldg.
DES MOINES . 919 Tuttle Street
DALLAS . . . 1223 Praetorian Bldg.
SEATTLE . . . 926 Lane Street
SANTA CLARA, CAL. . 625 Alviso Road

150,000-gallon water tank in Peru, Illinois. Exterior: NO-OX-ID Primer and a single, brush-application of Dearborn Aluminum protective coating. Interior: NO-OX-ID "A Special" . . . a heavy duty grease type preventive impervious to water.



Protect and Beautify

WITH

DEARBORN NO-OX-IDS

★

This 150,000-gallon water tank is one of three coated in 1947—both inside and out—with Dearborn NO-OX-ID Rust Preventives. During that time there has been *no* maintenance expense, and a recent inspection revealed it will be *unnecessary* to budget maintenance funds for another two or three years.

Records such as this are not the exception but the rule. Wherever the threat of rust exists, wherever metal surfaces must be protected against exposure to weather, corrosive fumes, water or humidity, you'll do that job best by specifying the correct Dearborn NO-OX-ID.

Dearborn Chemical Company, serving industry, utilities and municipalities since 1887, pioneered the development of chemically inhibited coatings to protect against corrosion. This broad experience is at your service . . . a Dearborn representative will gladly assist you in the selection of the correct NO-OX-IDS.

DEARBORN CHEMICAL COMPANY

General Offices: 310 South Michigan Avenue • Chicago 4, Illinois

WRITE FOR THIS VALUABLE BOOKLET

A complete introduction to Dearborn NO-OX-IDS with valuable information to help you protect against rust wherever it may exist.

DEARBORN CHEMICAL COMPANY
Dept. WS, 310 S. Michigan Ave.
Chicago 4, Ill.

Gentlemen: Please send me a copy of your booklet on *NO-OX-ID Rust Preventives.*

Name.....

Company.....

Title.....

Address.....

City.....*State*.....

Dearborn
Reg. U. S. Pat. Off.

THE ORIGINAL RUST PREVENTIVE

NO – OX – ID
IRON – RUST

How to eliminate heavy scum load—

CONVERT TO
PROCESS OXIDATOR

90 ft. conventional clarifier converted to Process Oxidator at City of Stockton, California. (Note absence of scum). Engineering office of Clyde C. Kennedy, Consulting Engineers.

ANOTHER example of the Process Oxidator's superiority was graphically illustrated at the North Stockton Sewage Plant. The sewage there contained a high concentration of cannery wastes, and the scum load was such as to create a nuisance. The conventional 90 ft. clarifier was economically converted to an Oxidator with the following results:

Removal of suspended solids increased from 55% to 78%.

B.O.D. removal increased from 25% to 45%.

Heavy scum load eliminated

Proof that this revolutionary one tank combination aeration, coagulation and sedimentation process causes fats, grease, oils, etc., to coagulate and settle to the bottom rather than floating as in the case of conventional settling tanks.

Whether you are interested in converting or planning a new installation, Process Oxidators are engineered to fit your needs. Write to either address below and one of our specialized Engineers will be glad to assist you with your particular problem.

Attention: New Bulletin No. 206 now available! Send for free copy without obligation.

INVESTIGATE THE PROCESS OXIDATOR

Installation will result not only in minimum scum handling, higher removal of suspended solids and greater reduction in bio-chemical oxygen demand but also in improved clarification, increased grease removal and elimination of odors by maintaining sewage in fresh condition . . . plus lower capital cost and upkeep.

PATENTED AND PAT. PENDING

PROCESS ENGINEERS INCORPORATED

821 MARKET STREET
SAN FRANCISCO 3, CALIF.

6381 HOLLYWOOD BLVD.
LOS ANGELES 28, CALIF.

1	Locating Leak
2	Breaking Through Pavement
3	Digging Bell Hole
4	Keeping Bell Hole Dry
5	Cleaning, Preparing Joint
6	Purchase Price of Clamp
7	Making Repairs
8	Backfilling
9	Repaving

What Price Permanence in Bell-Joint Repairs?

SO VERY SMALL is the cost of a Dresser Style 60 Clamp, compared to the total cost of a repair, that it makes permanence an outstanding bargain.

That's why so many cities make it standard practice to clamp bell-and-spigot joints whenever they are uncovered for *any* reason. Once installed, the Dresser Style 60 Clamp absorbs the vibration or movement that caused the leak. Eliminates the risk of losing your investment of time and labor due to failure of patchwork repair methods.

Whenever leaks occur in a bell-and-spigot line, whenever a joint is uncovered, whenever street paving is planned, whenever lines are subject to movement or vibration—"fix it once . . . fix it for good" with Dresser Style 60 Clamps.

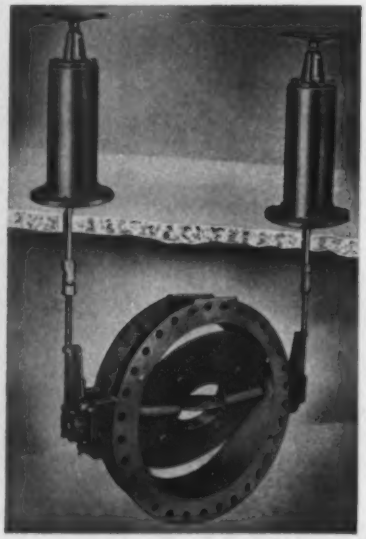
Dresser Style 60's come in sizes from 3" to 60", and are fully adjustable for tight fit on all classes of pipe. Write today for literature and prices.

DRESSER BELL-JOINT CLAMPS

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. (One of the Dresser Industries) • In Texas: 1121 Rothwell St., Houston • In Canada: 629 Adelaide St., W., Toronto, Ont. • Sales Offices: New York, Philadelphia, Chicago, Houston, San Francisco.

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



No. 737

36 inch x 8 inch heavy duty dual valve with 125-pound Am. Std. flanges controls maximum flow with a small pressure drop in large 36-inch valve. By closing large valve, small inner 8-inch valve controls small flow with high pressure drop. Separate handwheel controls for each valve vane patented. Automatic control and drip tight rubber seat available.

7 Advantages of R-S VALVES

1. Economy in first cost. Minimum number of working parts.
2. Body assemblies correctly engineered mechanically and metallurgically. Equal or exceed A.S.A. standards in every detail.
3. Only a few handwheel turns required for opening or closing.
4. Less inherent pressure loss reduces pumping costs.
5. More control rangeability. Readily adapted to automatic operation.
6. Self-cleaning—no pockets to capture sediment—no objectionable turbulence or wire drawing.
7. Rotary motion of shaft reduces stuffing box problems.

R-S PRODUCTS CORPORATION
Wayne Junction • Philadelphia 44, Pa.

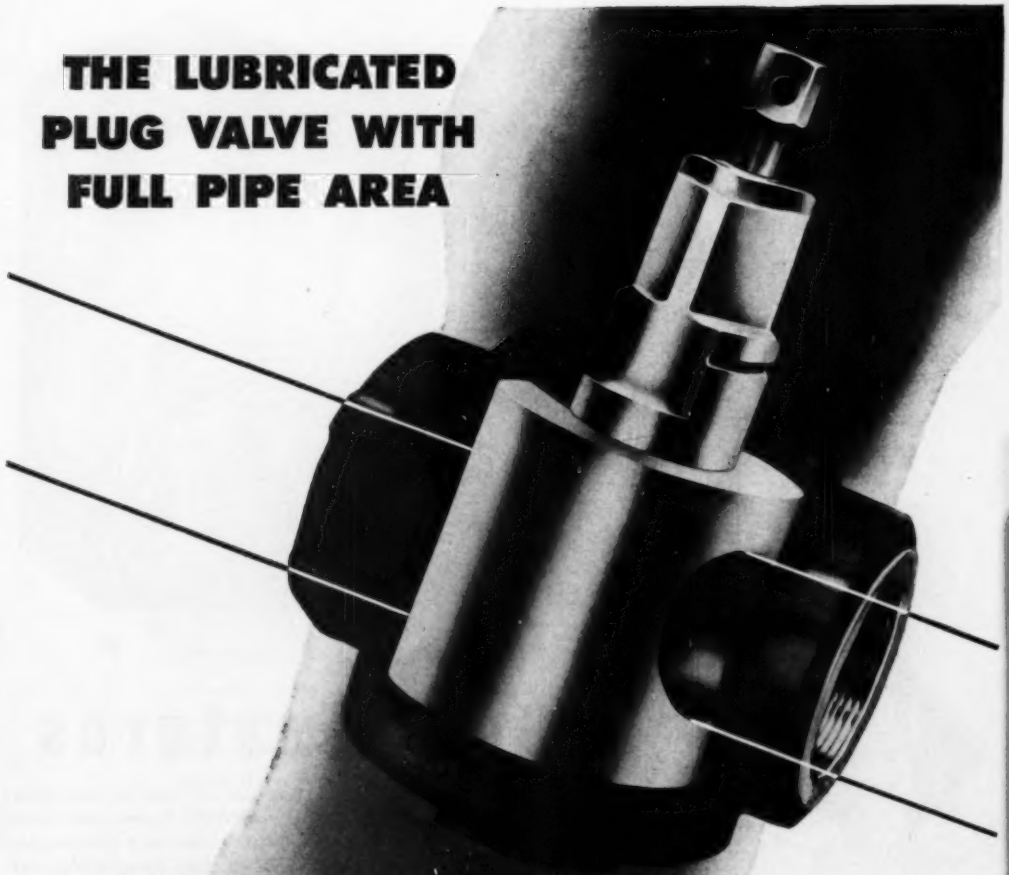
No. 680—Standard heavy duty valve with handwheel control—self-locking worm and gear. Automatic control and rubber seat available with 125-pound flanges. Rubber seated valves are drip tight with water at 100 psig and air bubble tight at 80 psig under temperatures up to plus 275° F. and as low as minus 40° F.

No. 771—Heavy duty wafer type valve equipped with handwheel control—self-locking worm and gear. One-piece body casting. Vane, shaft assembly and handwheel control identical with double flanged valve. Face-to-face dimension does not reduce torque. Flareout on body casting accommodates large mounting bracket base same as No. 680.

No. 734—72 inch 125 pound "H" metal valve for 800° F. Equipped with cooling fins, oil cylinder and positioner utilizing 200 psig operating oil pressure and 0-15 psig instrument air. Positioner cam driven simulating straight-line semi-log control curve or other characteristics if desired.

R-S field representatives maintain experienced engineering and maintenance staffs to study your valve problems, make recommendations and an appraisal of what you may expect from such studies. Specially trained factory representatives are also available for consultation.
Consult with your local R-S representative. Look for the address and phone number listed under "R-S Products, Valves" or write direct.

THE LUBRICATED PLUG VALVE WITH FULL PIPE AREA



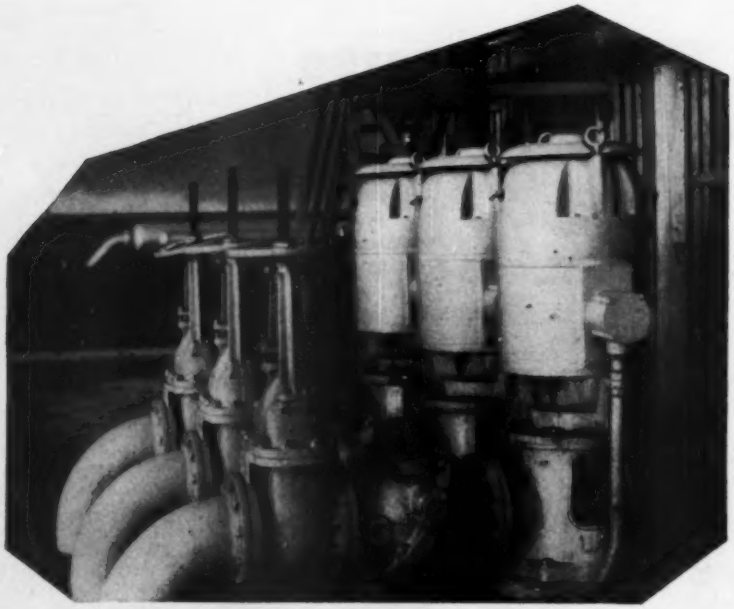
a.c.f. CYLINDRICAL PLUG DESIGN

makes it possible. Straight-through openings result in smooth, non-turbulent flow, lowest head loss, reduced valve abrasion. Yet compact valve construction is retained in both rectangular and round-port types. Reason enough for a.c.f. Lubricated Plug Valve preference.

a.c.f. CYLINDRICAL FULL PIPE AREA LUBRICATED **PLUG VALVES**

Representatives in more than 50 principal cities

Write for Catalog 4WS, describing types and sizes, to: American Car and Foundry Company, Valve Division, 30 Church Street, New York 8, N. Y.



VERTICAL TURBINE PUMPS

—are built in sizes from 40 to 16,000 gallons per minute. They may be installed in existing wells, saving the expense of a new drilling job. Other uses include fire protection, booster service, cooling towers, river pick up and a wide range of other uses. Send for the Layne Vertical Turbine Pump catalog.

GIVING YOU MORE

Good Features

Industrial Plant Superintendents, Water Works Engineers and Municipal Executives throughout the nation readily agree that Layne Well Water Systems and Layne Vertical Turbine Pumps have more good features than any other make. Such acceptance is due to Layne's extraordinarily fine designing, precision manufacturing and definitely superior installation methods. Furthermore there is a distinct advantage in owning water producing equipment built by an organization that is always ready and in a position to provide efficient repair and maintenance service when—and if needed. Hundreds of large water users of all kinds have found Layne equipment to be thoroughly dependable under every condition.

If you are in need of more water or want to consider the installation of a system of your own, the Layne organization is ready to offer experienced exploratory service, sound engineering advice and dependable construction plans. You incur no obligation in asking for this aid. For such service, catalogs, bulletins, etc., address

LAYNE

LAYNE & BOWLER, INC.
GENERAL OFFICES, MEMPHIS 8, TENN.

BUILDERS OF HIGH EFFICIENCY

WELL WATER SYSTEMS

ASSOCIATED COMPANIES—Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Pacific, Inc., Seattle, Wash. ★ The Layne-Texas Co. Ltd., Houston, Tex. ★ Layne-Western Co., Kansas City, Mo. ★ Layne Minnesota Co., Minneapolis, Minn. ★ International Water Corp., Pittsburgh, Pa. ★ International Water Supply, Ltd., London, Ont. ★ Layne-Hispano Americana, S.A., Mexico, D. F. ★ General Filter Company, Ames, Iowa.

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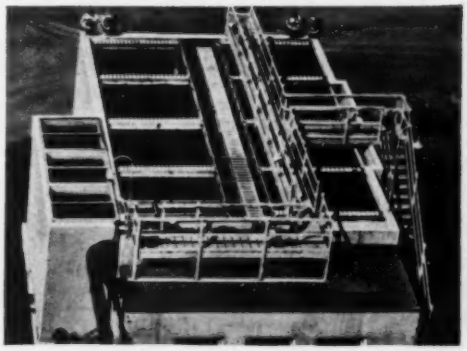

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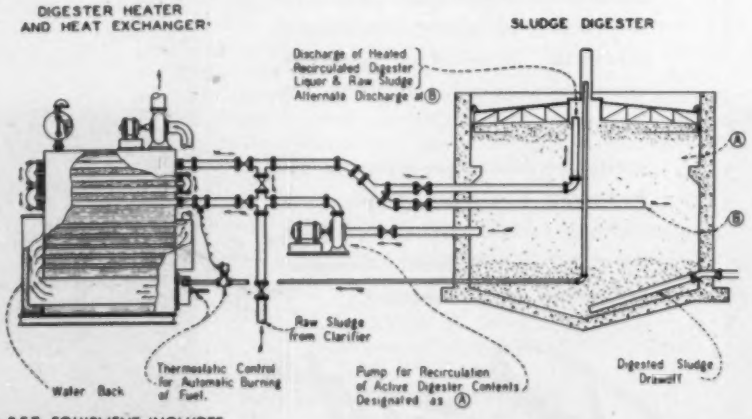
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(A)
(B)
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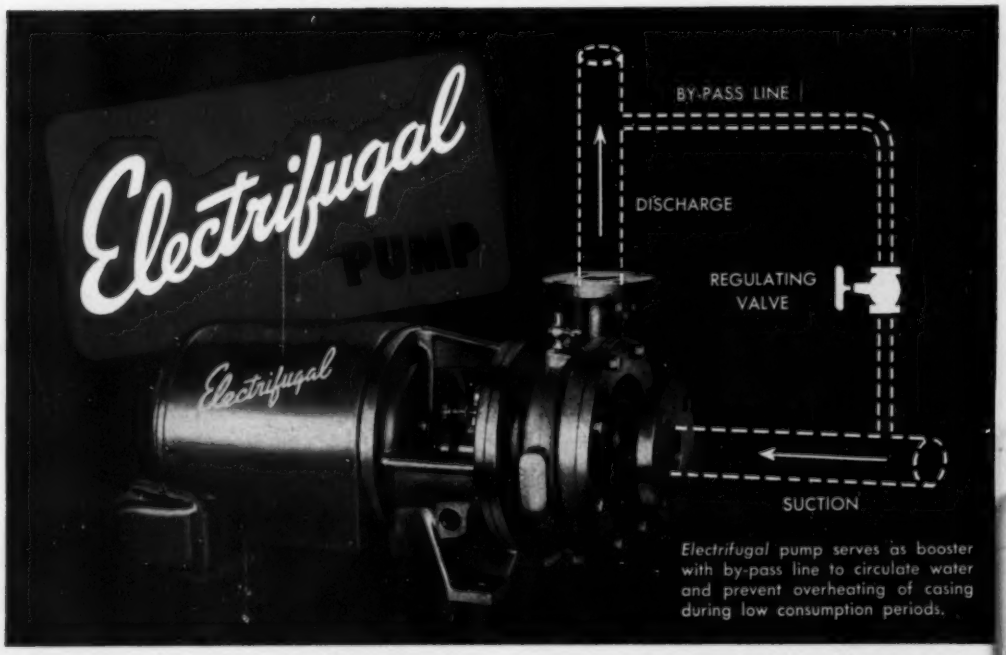

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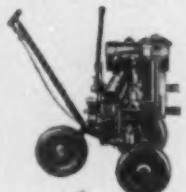

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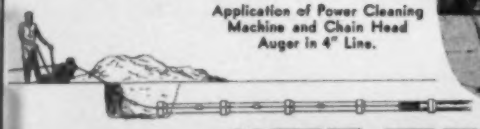

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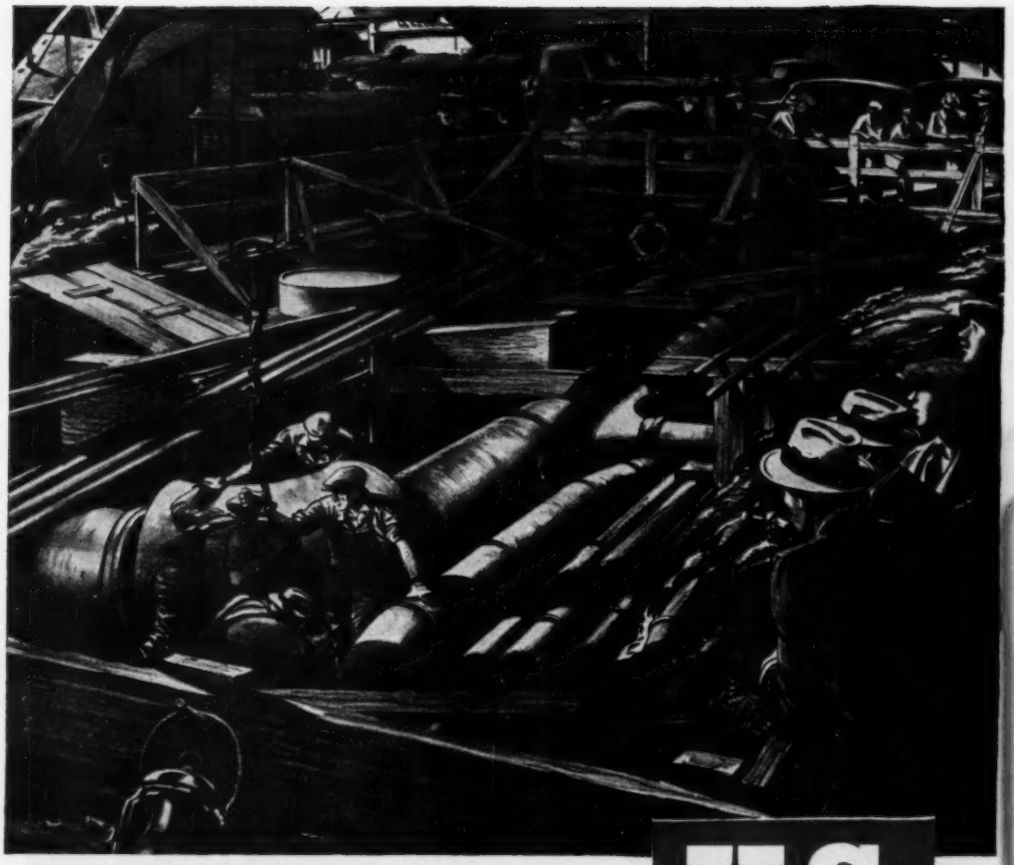

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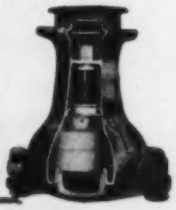

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WATER & SEWAGE WORKS

Vol. 97, No. 4 April, 1950

A Gillette Publication

THE SLUDGE BLANKET CLARIFIER

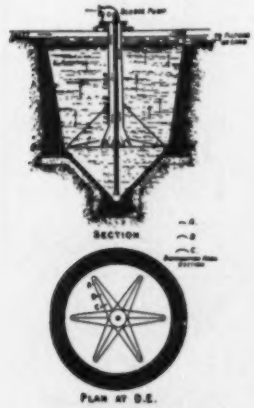
And, What is New in It
A Chronological Look at Its 80 Year History

by

FRANK D. PRAGER
Patent Attorney
CHICAGO, ILL.

IT is strange but noteworthy how much more is said about sludge blanket clarifiers in the early literature and historical books[1] than in modern textbooks on water and sewage treatment. Contrary to claims appearing in some of the current patents and advertising bulletins, the art seems to be quite old.

Indeed it was proclaimed as early as 1869, by Sillar and Wigner[2] that a certain chemically precipitated sewage sludge has a "power of precipitating" and that it may well be used "5 or 6 times over." The art was impressed by this discovery[3], although it was not clear, for the moment, whether this interesting "power" was due



The Author

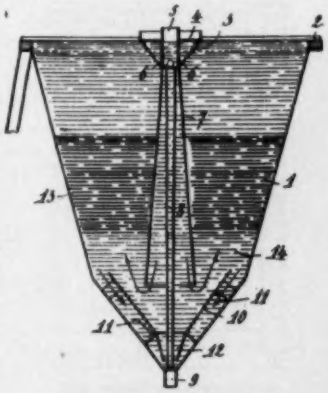
to unspent chemicals, or other agencies, or a combination of effects. It was obvious that the process can be performed in different types of tanks; for instance in the various inverted cone-shaped upflow clarifiers known from the previous patents of T. Walker[4]. It was also obvious that the process is applicable to water treatment, and Cotterell[5] applied it in this field[6].

The first large-scale application of the process was developed about 1880 by Mueller-Nahnsen and Kniebuehler of Dortmund in the Ruhr, under the name of the DORTMUND TANK. The principle of this clarifying unit, which was never patented, still survives in certain save-alls used in the paper pulp industry for separation of settleable solids from white-waters.

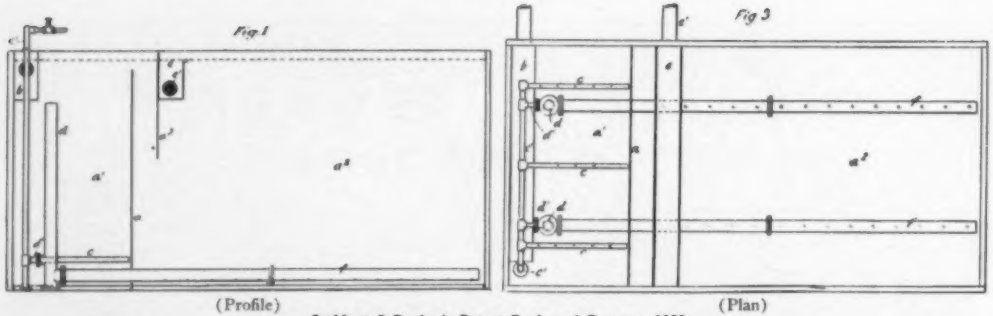
Originally it consisted in a vertical tank with a large cone-shaped or hopper-shaped bottom. This tank was equipped—crudely according to modern standards—for the suspension and use of a sludge blanket, by means of a device for central, downward, pulsating introduction of incoming liquid. Batteries of such tanks were often installed, with square bottom hoppers, omitting partition walls above these hoppers. The design was widely used in Europe, as shown by the literature[7] of 1890 to 1910. It attracted some interest at the World's Columbian Exhibition of 1893 in Chicago[8].

The suspended sludge blanket or "filter" of the Dortmund tank was studied in detail, with the aid of glass windows[9]. It was determined that success depends on at least daily removal of settled excess sludge[10]. It was clearly understood that the inverted cone design aids in keeping the sludge blanket from rising to the clear-water overflow at high flow rates; this can be seen for instance in the patents of

The Dortmund Tank—1880
(The earliest known sludge blanket clarifier.)



Aniceto's Patent Clarifier—1908
(An early attempt to improve the cone arrangement.)

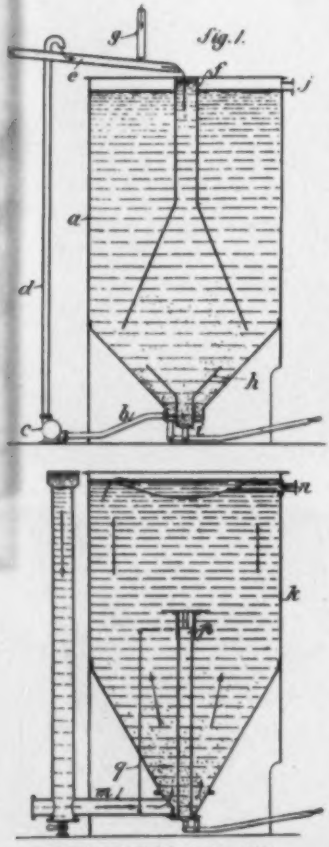


(Profile) (Plan)

Archbutt & Deeley's Patent Tank and Process—1892

(The most important early sludge-blanket clarifier. Used one compartment for sludge mixing and another for clarification. The process, called "Accelerated Precipitation," proved a complete success.)

Antoine[11]. The attempt to keep the sludge blanket from dropping out of contact with the liquid under treatment at low flow rates was less successful. The "pulsating flow" was applied for this purpose, by means of ejectors. Mechanical difficulties were encountered with these ejectors[11]. In later years the tanks were usually operated as plain upflow clarifiers. However, it was clear that a more elaborate agitator would go far to remedy the situation. Aberg[11], for instance, designed a power-operated, rotating, vertical-shaft agitator, with a cooperating set of radial stationary baffles to create suitable eddy currents in the lower part of the tank.



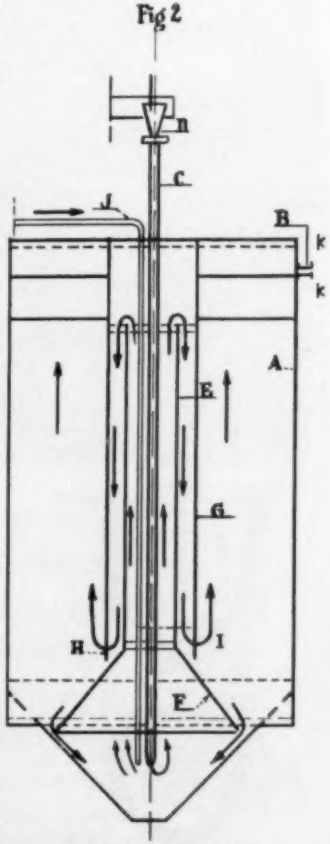
Declercq's Patent Tanks—1903

(Featured sludge recirculation for accelerated precipitation and clarification with inverted cone inlet.)

An Important Early Sludge Blanket Clarifier

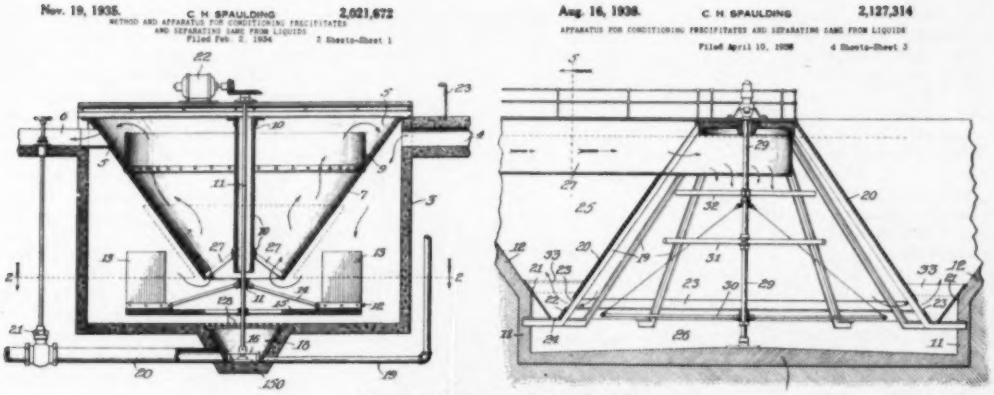
The most important, early sludge blanket clarifier was covered by a patent awarded in 1892 to Archbutt and Deeley[9]. It provided most of the features mentioned up to this point, and moreover used two distinct but intercommunicating compartments, one for mixing and another for clarification. The settling compartment (see cut) had pickup pipes installed at the bottom, forming the suction lines of a pumping system. Excess sludge was removed through these lines, but most of the sludge was returned through branches of these lines to the smaller, adjoining mixing compartment. Here it was mixed and agitated with incoming raw water and softening reagents, and the mixture then went to the clarifying compartment, in a downward flow, rising finally to the clarifier overflows. The recirculation and agitation was effected by pumps consisting either in power-operated airlifts, as shown in the patent drawing, or in screw propellors, as mentioned in the patent specification. The process was called "ACCELERATED PRECIPITATION." It was a "complete success"[10].

The inventors of this process are, perhaps, better known as the originators of recarbonation[9]. This improvement, historically even more important than sludge recirculation, was clearly and completely disclosed in the early work of Archbutt-Deeley, relating to an intermittent process[9]. It was also understood, by that time, that the acceleration of the precipitating process is due to seeds or nuclei provided by old precipitates, as distinguished from any unspent chemicals.



Lamy's Patent Tank—1909

(An extremely interesting adaptation of sludge recirculation by air-lift and up-flow clarification.)


Nov. 19, 1935. C. H. SPAULDING 2,021,672
METHOD AND APPARATUS FOR CONDITIONING PRECIPITATES AND SEPARATING SAME FROM LIQUIDS
Filed Feb. 2, 1934 2 Sheets-Sheet 1
Aug. 16, 1938. C. H. SPAULDING 2,127,314
APPARATUS FOR CONDITIONING PRECIPITATES AND SEPARATING SAME FROM LIQUIDS
Filed April 10, 1936 4 Sheets-Sheet 3

Spaulding's Patents of 1935 and 1938

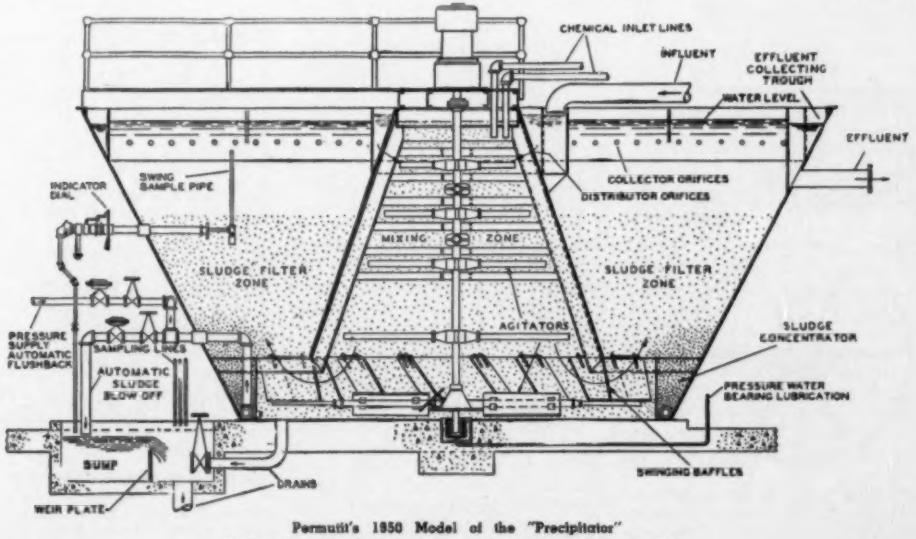
(Resurrected and modernized the all but forgotten process of "Accelerated Precipitation" in tanks with conical members providing up-flow sludge blanket clarification. The development proved a turning point in softening and clarification.)

The processes of Archbutt-Deeley were promoted by the firm of Mather and Platt in Salford, England. In that town Corbett, well known in the history of the activated sludge process, was City Engineer. It would be interesting to know whether airlift studies of Corbett had an influence on Archbutt-Deeley or vice versa. This question was raised in the Milwaukee Activated Sludge suit, but little was clarified by the decision of that suit.

The precipitation of hardness with "ACCELERATION BY SLUDGE" was known in France as well as in England, about 1900. It was studied in further detail by Declercq[3], the successor of an enterprise started by one Gaillet[4], and the predecessor of what is now the French associate of the Permutit Co. Declercq improved the recirculating process by using a sequence of mixing operations wherein "the water already holds in suspension, at the moment at which the action of the precipitating reagents is able to begin, particles of old precipitates," in order to avoid the formation of inefficient, pin-point flocs. Further, Declercq preferred to recirculate and suspend a light or medium sludge, rather than the heaviest particles, because he found that "beyond a certain diameter the efficacy of the particles appears to diminish." Finally he disclosed that recirculation may be adjusted to provide a ratio of old to new materials as low as 5:1 or up to 100:1 "or even more." He stated these ratios on a basis of solids; the 5:1 ratio of Sillar and Wigner had been on the basis of fluid volumes.

The Declercq process was as successful as that of Archbutt and Deeley. In 1909 it was further developed by Lamy[5], one of Declercq's engineers. Lamy's tank can best be described as an "Accelator" with airlift-actuated sludge recirculation.

It would seem that little remained to improve. However the art develops seldom along perfectly logical lines. Mather and Platt promoted the early, intermittent Archbutt-Deeley process more than the continuous one. Declercq promoted his simple tanks more than the elaborate Lamy tank. Meanwhile the entire idea of sludge retention was somewhat discredited by the failure of a variant introduced



Permutit's 1950 Model of the "Precipitator"

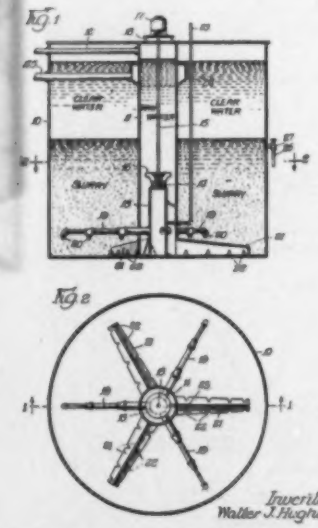
(Is based on Spaulding's patents which Permutit Co. controls.)

by Lawrence, Maignen and Desrumeaux[31], wherein the clarifying zone was filled with inclined plates, so-called settling plates. These were intended to accelerate sedimentation, but actually were nothing but an expensive nuisance. Shallow tanks with horizontal flow, basically known since time immemorial, began to supersede the deep upflow tanks, in Europe and in the few American cities that had been equipped with upflow settlers, such as Vicksburg, Miss., and the Quindaro plant of Kansas City, Mo.[32] Some extra confusion was created by a sudden insistence on intermittent settlers, at St. Louis, Mo., about 1890. As a result, little was done with accelerated precipitation between 1910 and 1935.

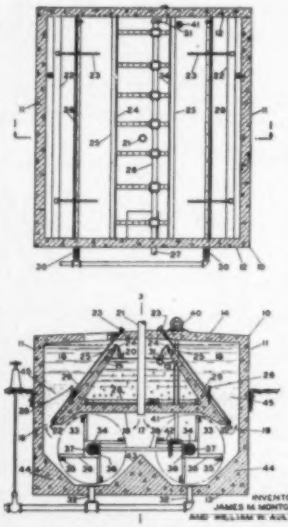
Of course vertical tanks remained in use for relatively small lime-soda softeners and the like. Sludge recirculating or suspending methods were still used or patented or repatented, for instance by Koyl[33], Linden[34], Kleinbentink[35], Vater[36], Behrman-Green[37], C. P. Hoover[38] and M. C. Smith[39].

A New Turning Point—Spaulding's Contribution

A new turning point came in the early part of 1934, when Chas. H. Spaulding filed his first and basic patent[40] for the "PRECIPITATOR" process. The patent was issued about the end of 1935, it is now controlled by the Permutit Co. and expires in 1952. It showed an inverted cone-shaped up-flow vessel, very much like the old Dortmund tank and just a little wider and less high than the tanks illustrated in the patents of Aberg, Declercq, Lamy and Linden. Like Lamy and others, it provided two separate but intercommunicating compartments; and it employed the same device as shown by Aberg to set up "backflows" from the clarifying to the mixing compartment.



The First Step Toward the Infilco "Accelator"
(The patent tank and process of Hughes (1941) which resembled closely the Archbutt-Deeley disclosures of 1892.)



The Horizontal Patent Precipitator of Montgomery and Aultman—1941
(See text for unique features.)

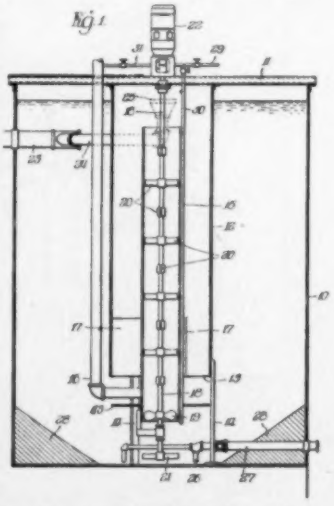
The results were basically the same as those observed by Antoine and others. With proper operation a clear separation could be maintained between the suspended sludge blanket and the treated water. Spaulding used the term "slurry" for the suspended sludge blanket or filter. This, of course, was only a new application of an old ore handling term. A more important feature, however, was new in substance: Spaulding stated, modestly but significantly, that the complete process (starting with the chemical precipitation in the mixing compartment and ending with the complete separation of the treated water, at the top of the cone) can be "quite rapid." He mentioned a specific example, involving the removal of calcium and magnesium hardness in about 125 minutes (1.4 MGD in a tank of 32′ dia. x 20′ height).

In other words, Spaulding discovered (or rediscovered) the potentialities of the process of Aberg, Lamy and his other predecessors. He tested it with good materials and mainly with careful attention, and found it much more efficient than anybody had assumed, at least in the United States. In principle, these potentialities would have been known if the profession had read and digested the pertinent literature with greater attention[41]. Nevertheless, there is hardly any doubt that Spaulding's basic disclosure had pioneering merit in a practical sense. It ended the period of almost absolute preference for the shallow, horizontal-flow tank, and brought the upflow tank with a positively suspended, protected sludge blanket back into its own right. On the American scene, it was practically the first time that this type of tank was used.

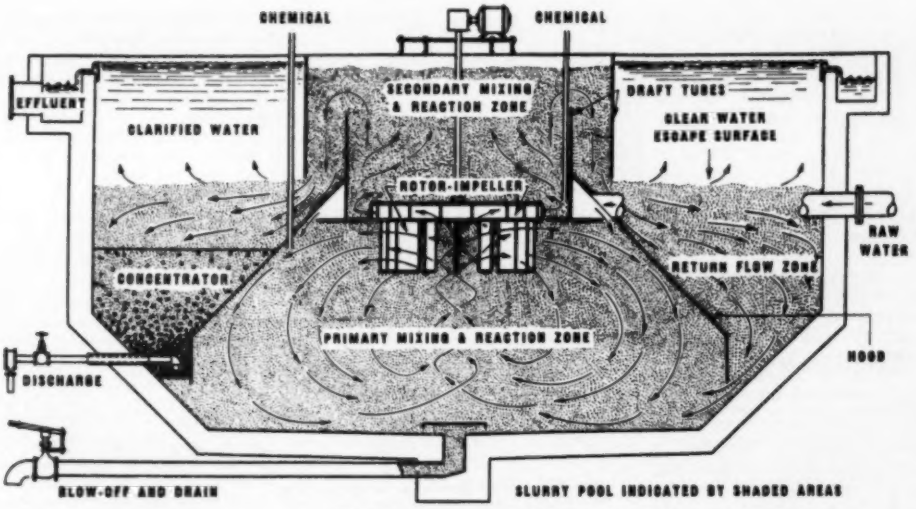
The merits of the *claims* in the Spaulding patent are a different matter. The basic claim of Spaulding reads:

> "A method of softening water, comprising:
>
> First mixing the raw water with a soluble precipitating agent in an agitating zone, and then—
>
> Flowing the mixed water, reagent and partly formed sludge upwardly through a quiescent precipitating zone open at the bottom and free from undissolved precipitating agent, and—
>
> Causing the water to rise through the precipitating zone at constantly decreasing velocity, the velocity at the bottom being sufficient to support all but large sludge particles and that at the top being insufficient to support any substantial sludge particles—
>
> Whereby, a considerable volume of sludge remains suspended in the lower part of the precipitating zone and acts as "seed," and the larger particles as formed descend out of the precipitating zone."

This is hardly adequate. At the point that is emphasized most strong-



The Second Development Toward the Infilco "Accelator"
(The patent tank and process of Hughes (1941) which follows closely the patent process and tank of Lamy—1909.)



The Infilco "Accelator" of Today

(Employs a combination of perfected processes and tank design based on the Hughes patents.)

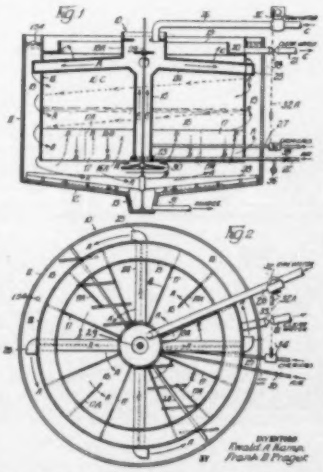
ly, the rising flow with constantly decreasing velocity, the claim is not only vague in its reference to "large" and "substantial" sludge particles; it also fails to point out anything *new* over the tanks of the prior art. This art was alluded to with equal vagueness in Spaulding's specification. All really pertinent references were completely overlooked by the Patent Examiner, domestic and foreign patents and unpatented designs alike.

In some of the more specific claims the Spaulding patent proposes to bring "seed" into the "Precipitator," especially in form of powdered coal or coarse activated carbon. This is just as old as the basic method[8].

Not to belittle the recognition due Spaulding for his scientific approach and developmental work, it is none the less regrettable that the examination of *any* patent application can be so superficial as it was in this case.

What follows after Spaulding's first and basic patent is in the nature of detail improvement, in view of the well-developed state of the art as of 1909 and the pivotal importance of the first Spaulding disclosure. Indeed the remaining "Precipitator" patents (if not all of the others which follow in this article) are clearly drawn to cover detail improvements.

Spaulding's second patent[8], disclosing what is now the standard Permutit "Precipitator" design, was filed several months after the grant of the first patent. The claims cover an improvement of small scope; that is, a tank wherein the outer wall has inverted frusto-conical form and the inner partition, surrounding the mixing compartment, is part of an upright cone. The claim does *not* cover, for instance, an upright cone inside a cylindrical tank. This latter arrangement was already suggested in the first patent, which stated that the mixing and clarifying vessels are "generally in the same vertical plane," while leaving it open whether the mixing vessel is inside or outside. The second Spaulding specification points out particular advantages of the construction using an outer, inverted cone frustum, and this is all that the claims cover.



The Patent Tank and Process of Kamp and Prager—1945

(A modernization of the Seip tank and process of 1937 with sludge recirculation.)

Incidentally the second patent states that a 70′ diameter tank had been operated with 58 minutes detention. It fails to specify the kind of treatment, being less definite in this respect than the first patent. The claims do not cover any procedural improvement. This patent, which expires in 1955, about three years after the first, is relatively unimportant.

Horizontal Precipitator of Montgomery and Aultman

The so-called horizontal, better RECTANGULAR PRECIPITATOR is protected by a patent awarded Montgomery and Aultman[9], of California, expiring in 1958. As in some other patents, the claims are confusedly arranged; a fact which cannot be blamed on the inventors and does not affect the validity of the patent but is still regrettable. Claim 4 describes the improvement in the relatively broadest terms. It calls for an inclined wall defining an upper and a lower chamber in the rectangular tank; an opening between one sidewall and the lower edge of the inclined wall, through which the chambers communicate; and agitator blades on horizontal shafting, moving downwardly near the opening. Liquid, of course, is admitted to the lower chamber and withdrawn from the upper chamber. Claim 11 describes the same arrangement with two parallel upper chambers. Claims 1, 6-10 and 12 add a partition, to form a third compartment for recarbonation or the like. Claim 5 adds another partition, forming a sludge concentrator on the inclined wall; Claim 2 makes the opening between

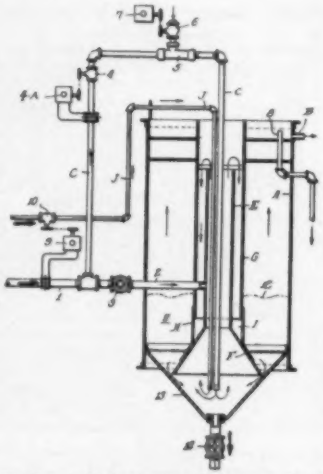
the chambers adjustable. Claim 3 adds concrete fills to eliminate dead spaces or low velocity areas in the lower chamber. Basically, this patent covers a flocculator with a superposed, upwardly expanding upflow clarifier. An underlying flocculator has advantages, at least when the necessary overall height can be made available economically. Of course it also introduces problems, mainly as to the agitator design. A light hydroxide sludge is easily suspended in the Montgomery-Aultman upflow zone; but it is not nearly as easy to suspend a slurry of heavy calcium carbonate. In this respect the original Spaulding "Precipitator" is more efficient.

(Note: In the Marsden C. Smith patent[20] of 1933, mentioned earlier, the clarifier is practically on the same level with the flocculator, and has *horizontal* flow.)

Other precipitator patents were issued: a third patent to Spaulding[21] relating to slurry removal above the bottom or "as a divergent side stream"; two patents of Gurney[22] relating to multiple tray precipitators, and precipitators with special sludge concentrating chambers; and two patents of Green[23] (controlled by Infilco), relating to precipitators with more positive, vertical sludge recirculation, a feature anticipated in the old Kleinbentink patent overlooked by the Patent Examiner, as usual.

The "Accelator"

Next we have to discuss the Infilco ACCELATOR patents of Hughes. The first of the Hughes patents[24] describes a tank arranged in exact accordance with the Archbutt-Deeley disclosure for "Accelerated Precipitation," except that Archbutt-Deeley's



The Proper Modernization of the Lamy Tank and Principle—1948

(An unpatentable adaptation of Lamy's process in a "Reactivator" especially suitable for the smaller installations.)

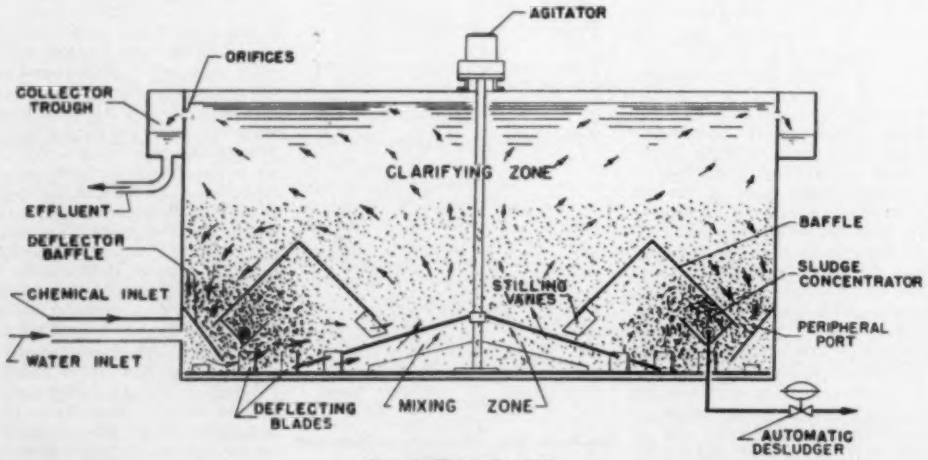
return passage to the clarifying section is simpler. The second Hughes patent[25] shows, essentially, a replica of the Lamy tank, except that Lamy has a more elaborate design, with respect to the hood at the bottom of the slurry circulating tubes, thus possessing a greater similarity to the actual form of the "Accelator." The Hughes patent shows only an embryonic "shelf," but makes an indirect remark that the shelf can be enlarged[26]. In the examination of the two Hughes patents, the pertinent art was again overlooked by the Examiner.

In the specification of Hughes much is said about the "slurry"; however, this material, and the feature of suspending rather than settling it during the process, was well known from Spaulding and his predecessors. As to all important details concerning the "slurry," the action of its particles, the rates of recirculation, etc., old disclosures like Declercq are considerably more informative than the Hughes patent although the Hughes specification, seemingly, leaves "no stone unturned."

No doubt the "Accelator" is an efficient device, and process, and it is known that Hughes is a meritorious inventor of various zeolite and filter controls. However, I fail to see anything really *new* in the "Accelator," when comparing it with the tank and process of Lamy and his predecessors. It is true that the prior art had been widely forgotten during the period 1910-1935; however, it was available but apparently was not rediscovered by Hughes in the development of the "Accelator."

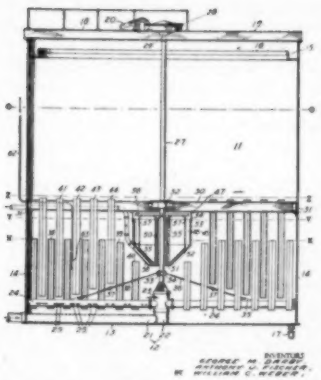
Most of the process claims emphasize the basic old feature of suspending sludge particles rather than settling them, either expressly or indirectly. One separate patent[27] applies the process to coagulation; another[28] to the stabilization of unstable solutions. The broadest terms are in the two basic patents. They are numerous, widely divergent in their specific recitals and, as so often happens, are confused in arrangement. They even include one claim that was expressly cancelled during the prosecution.

Sometimes the "Accelator" process is credited to the old, expired Behr-



Liquen's "Reactor" of 1947

(The Cochrane Corp. now offers a "Reactor" which closely follows the design of the "Accelator.")



The First Stage of the Dorrco "Hydro-Treator"
(A patent granted Dorr Co. employees in 1941. The influent enters either through revolving distribution pipes near the floor level or through a special gate-type mixer or a combination of both. The flow is upwards through the sludge blanket.)

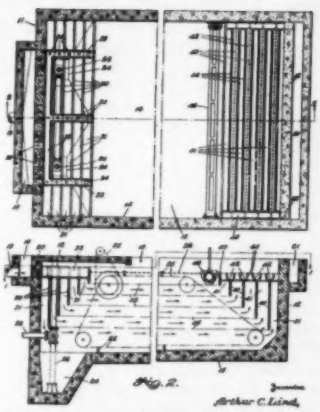
man-Green patent[37] of 1927. It must be noted that in that case the Patent Office had overlooked the pertinent foreign and domestic art, just as it did in most other cases. Likewise, the Behrman-Green and other patents were also overlooked, subsequently. Thus, the incredibly superficial action of the Patent Office has resulted in successive patent monopolies which appear to be completely unjustified.

Even a detail such as the interior sludge concentrator patented to Green[38], for all that I can see, is anticipated by Declercq, Antoine and others. Considerable debate has taken place about this concentrator, in patent interference proceedings involving Green and others[39] but little, if anything, has been disclosed that added to the information already available to the engineering profession.

In other Infilco Accelator patents Green[40] combines the vertical sludge recirculating tubes, known from Lamy and Hughes, with different forms of sludge scrapers and other attachments. He has also proposed a multiple tray "Accelator"[41], and another modification with settling plates in the slurry zone[42], and also other modifications of the standard "Accelator"[43]. Barrington-Green[44] and Prager[45] have developed further modifications. Finally Green[46] and McBride[47] have tried to apply the device, with still further changes, to applications in the treatment of chemical process liquors, sewage, sugar juice, and paper waste.

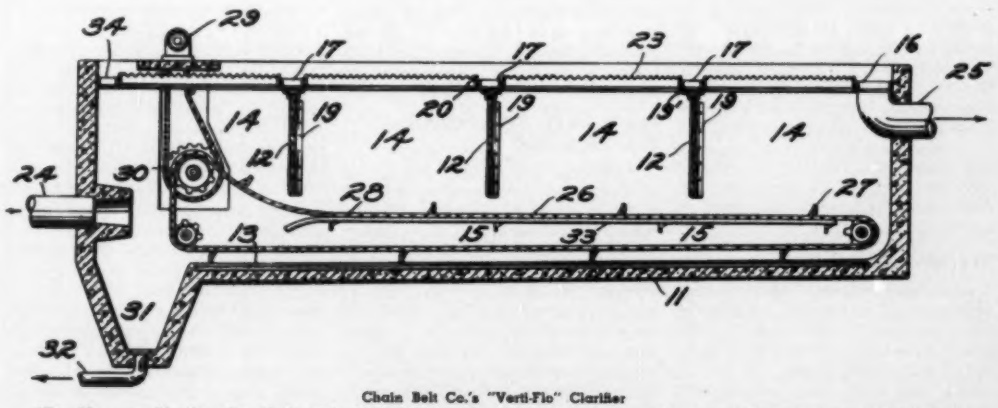
The "Reactivator"

Shortly before Spaulding's first patent Seip[48] had developed a "sludge filtration" tank of very similar design; that is, with an outer flocculation channel and an inner, upwardly expanding clarification zone for upward sludge filtration; however he had provided only slow-moving sludge scrapers instead of relatively rapid agitators. This design was developed into the "REACTIVATOR" of Graver Water Conditioning Co. Welp[49] modified the bottom design so as to utilize relatively light and medium-weight sludge particles, not the heaviest ones, as previously taught by Declercq. Then Prager and Kamp[50] provided the Seip clarifier with a sludge recirculating system, using a pickup device at the lower, central part, and conduits distributing the returned sludge along the top of the peripheral flocculation channel. Modifications of these conduits, mainly for large tanks, were developed by Bieker-Welp, Galandak, Kamp, Prager and Welter[51]. Special flow deflecting and adjusting features were added by Felsecker[52].



The Lind Patent Tank of Chain Belt Co.—1947
(Known as the "Strati-Flo" clarifier, because the flow is horizontal rather than vertical.)

A second type of "Reactivator," more similar to the Lamy tank, is also in use. It is basically unpatented and unpatentable. Improved scrapers and other details were designed by Prager and Parker[53]. The Seip form of the "Reactivator," with the peripheral channel, is used for tanks of larger diameters; the Lamy form with a central flocculation zone is used in medium and small size tanks. The design is conservative in both instances. It uses standard methods of continuous sludge removal, and elaborate systems of overflow weirs and launders for the clear water. Some of the "Reactivators" feature airlifts for the recirculation and suspension of sludge blanket material, also aiding in the removal of CO_2 and carbonate hardness. The airlift also results in the maintenance of frequently desirable aerobic conditions in the sludge, as clearly sug-



Chain Belt Co.'s "Verti-Flo" Clarifier
(Provides a combination of vertical and horizontal flow and chain-scraper sludge mechanism. Patent has been applied for.)

gested by Archbutt-Deeley and others[28]. In the design of such airlifts it is not desirable to develop too minute airbubbles. Emulsified air would drift with finely divided materials into the clarification zone; therefore relatively large air discharge nozzles are used.

To a large extent the "Reactivator" patents cover detail improvements, relating to apparatus, not process features. Attempts are made to provide the most suitable velocities for the various stages of the old basic process by means of simple and efficient flow guides. The early models were relatively heavy and expensive, as a result of the utilization of a number of distributing conduits; this gave occasion to the development of the later Seip forms and the Lamy form "Reactivators." Several of the detail improvements are applicable both in clarifiers without sludge blanket treatment, and in the more rapid "Reactivators." These improvements include an improved rim drive by Durdin[29] and a viscosity-responsive sludge valve control by Kamp[30].

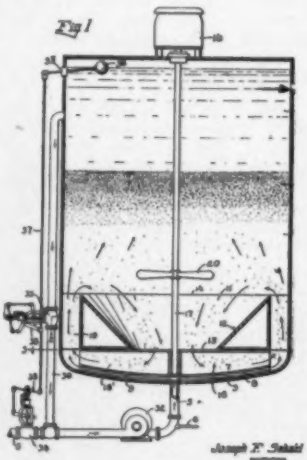
The "Reactors"

The Infilco "Accelator" is supplied by Cochrane under the name "REACTOR." Another "REACTOR," slightly resembling the Permutit "Precipitator," was built by Liquid Conditioning Co. for some time. Here the inner, conical partition of the "Precipitator" was dissolved into a set of concentric, truncated, cone-shaped baffles, installed entirely below the water level but above a large, horizontally rotating agitator. The entire tank area was thus utilized for the release of clear water from the sludge blanket, a feature of some advantage, although its importance may have been overestimated.

Such a submerged set of baffles can also be viewed as an intermediary between other, fairly well-known types of slurry clarifier, using either a horizontal screen[31] or a set of more or less horizontal baffles[32] between a lower mixing zone and the top overflow. Theoretically, if depth is not a serious consideration, these arrangements can be very advantageous. However, caution must be exercised to provide sufficient access to the impellors, and difficulties may arise if rim drives are wanted.

The "Hydro-Treator"

A hybrid between modern conventional and accelerated systems of precipitation was developed for the Dorr Company under the name "HYDRO-TREATOR." It uses a special gate-type mixer, integral with the sludge scraper arms, as designed by Darby & al[33], or special, revolving pipes for the distribution of the water over the bottom of the tank, as designed by Dorr & al[34], or both expedients together, sometimes in combination with special sludge concentrators and other tank features. The "Hydrotreators" do not utilize the partition, introduced by Archbutt-Deeley, which protects the clarification zone from the agitation required for suspension and distribution of a slurry; as a result, they will not always allow the maintenance of a blanket of such



The Sebald-Worthington Process & Tank—1945

(Worthington Pump & Mach. Corp. offers this for hot or cold water treatment. The unusual feature is the recirculation of treated water rather than sludge or slurry.)

material below the water level. Green[35] of Infilco has taken out a patent for what is in effect a "Hydrotreator" with a separate mixing zone of the Lamy type. It is questionable whether the "Hydrotreator" features serve any purpose when such a mixing zone is provided. There is certainly not much use for the gate-type mixer together with the central mixing zone.

The "Verti-Flo"; The "Clariflow"; The "Flocsettler"

Additional tank designs for upflow treatment without partition between agitation and clarification zones are used by the Chain Belt Co. One is the rectangular "VERTI-FLO"—no patent to date—; the other, also rectangular, is called "STRATI-FLO" and is patented to Lind[36]. Both are using chain-actuated flights as agitators and scrapers—as did, for instance, an earlier design of Hawley[37]. More elaborate designs, with partitions between the principal zones of a rectangular device, are patented to Green[38] of Infilco and of course to Montgomery-Aultman of Permutit.

The "CLARIFLOW," classifiable as an upflow or slurry clarifier but not patented to date, is being built by Walker Process Equipment Inc. The so-called FLOCSETTLER of American Well Works, designed by Walker[39] gave cause for a patent complaint by Infilco under the first "Accelator" patent. The suit was amicably settled during 1948.

Control features, mainly valve systems for tanks of this type, applicable to the hot or cold process of softening, have been patented by Robinson and Sebald[40] of Worthington Pump & Machinery Corp. The system of this concern is based on a recirculation of *treated water*, not of suspended sludge; this is generally known from Declercq and others[41], but has been refined by Worthington in a number of details.

With the exception of Permutit, other concerns have paid little attention to the possibilities of accelerated precipitation in hot process treatment. Of course both precipitation and sedimentation are more rapid in hot water than in cold water, even without further aid; but it is quite possible that still further acceleration may be achieved.

In Summary

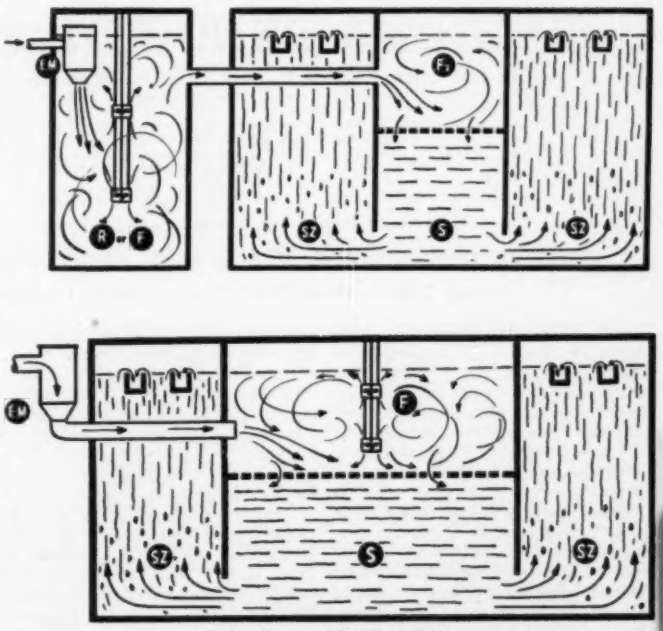
It is obvious that "Accelerated Precipitation," with the aid of recirculated sludge, has come into its own after the long delay during the early part of this century. It has not displaced and probably will not displace what is commonly considered standard-rate precipitation and settling, which continues to play a useful part in the removal of very high turbidities, and in the treatment of water for cities or industries which are mainly interested in simplicity more than in saving of space and investment requirements.

There is no strict dividing line between the conventional systems of precipitation and the most modern forms of accelerated precipitation. The transition is a gradual one; much more gradual, for instance, than the transition from low rate to high rate trickling filters in sewage treatment.

Some advertisements appear to be attempting to create the impression that the new patented devices will always work perfectly in less than 1 hour, when everyone else needs 4 hours or more for even a less perfect job. Actually it has long been established that 2 hours is a good practical period on the average[42] except when using the process refinements of Declercq, which permit a reduction to

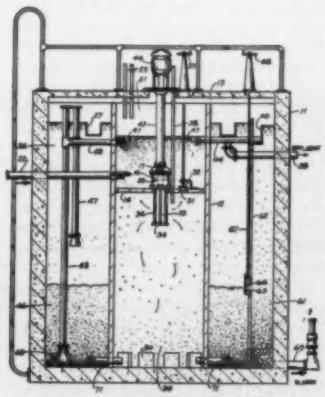
about 1.5 hours, or sometimes 1 hour. When not using the basic teachings of Archbutt-Deeley and predecessors, it is true that three or more hours may be required. The fact that industry has long put up with retentions of 4 to 6 hours in chemical precipitation and sedimentation plants had more to do with indecision in the adoption of basic parts like agitators, flocculators and recarbonators, than with the evolution of the treatment tanks and processes.

It seems that industry has now overcome that indecision, and full use is being made of all foreign and domestic teachings (both new and not so new) in the constant effort to achieve finer control over the quality of process waters. Higher standards may still be attained, for we still have too frequent upsets in our treatment procedures—a condition which needs to be remedied. We also have questionable ads and, unfortunately, glaring deficiencies in our patent classification and examination procedures. However, definite progress *has* been made, and further progress can be expected.



Walker Process "Clariflow" Units

(The Separate Type for mixing and clarification in separate units is shown above, and socalled Nested Type below.)



Walker's Patent Upflow Tank—1947

(Another modification of the up-flow slurry blanket clarifier.)

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ELECTRICITY OUSTS GARBAGE MAN AND UNSAVORY GARBAGE CAN

Indiana Town to Save $14,000 Yearly Through Garbage Grinding, at Source

The above headline in Feb. 16th newspapers told of the outcome of a vote by the majority of property owners of Jasper, Ind., and an ordinance passed by the City Council which will outlaw the garbage can and substitute household garbage grinders, discharging to the sewer system of Jasper.

Readers will recall a news item in *Water and Sewage Works* a few months ago, that told of the special act of the Indiana legislature which permits Indiana communities to finance the installation of household garbage grinders and collect for such installations on a monthly payment plan.

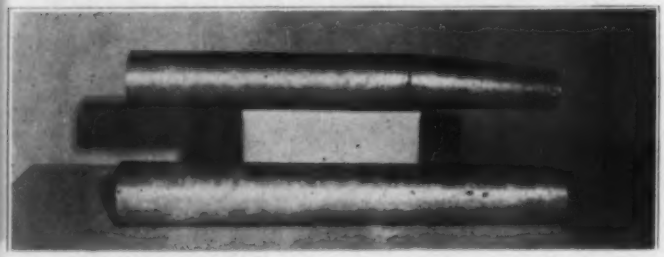
Jasper (pop. 6,800) figures that it will save between $14,000 and $18,000 per year under the new ordinance, which eliminates all public garbage collection and prohibits the outside garbage can. The ordinance does not make it mandatory for residents to purchase the $75.00 "Disposall" Units, but does the next thing to it, in that the householder is required to dispose of his garbage through odor-free incineration, burying, or other methods. It prohibits storage of garbage in cans, or otherwise, on the property outside of the residence or other buildings.

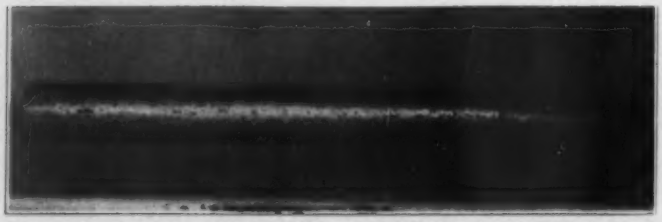
The City of Jasper will stock and sell to the public the "Disposall" Units. The local banks will provide loans on a liberal basis to those who can not pay the $75.00 cost of the grinders at one time.

The Jasper Plan was developed with the guidance of consulting engineers who reported favorably on the scheme of waterborne garbage disposal via the new sewage treatment plant, which we understand was designed to handle the garbage loading in addition to the community's domestic sewage.

Jasper, Ind., has set a precedent in garbage disposal practice and means of financing the adaptation of the household garbage grinders required to render the plan operative and practical. The Jasper experiment will be watched with interest by the sanitary engineering profession.

THE "SEWA-BAZOOKA"*





The three cuts picture the "Sewa-bazooka" which has proved so useful in Moultrie, Georgia. It is made of 24 gage galvanized metal. It is 3" in diameter at the small end and tapers to 5" diameter at the larger end. It is 5 ft. long, with a two-foot adjustment by the telescoping of the two sections.

The "Sewa-bazook" is used where it becomes necessary to lay new mains or replace old ones in a street, where the house sewer laterals will cross the trench.

As the ditching machine cuts the ditch the lateral sewers are severed by it. Right behind the machine a man places the small end of a "Sewa-bazooka" in the outlet side of the lateral and slips the large end over the other end of the cut lateral. This operation requires very little effort and these units can be used over and over.

After the water main is in and tested the "Sewa-bazookas" are removed and the sewer lateral repaired. By this means little or no sewage gets into the pipe ditch, thus reducing dangers of contamination of the new water main to a material extent.

*A contribution from J. R. Jacobs, Supt. of Water & Sewage, Moultrie, Ga.

HEADACHES, HUNCHES AND HARD WORK

Pages from the Life of a Superintendent

(Second Installment)

by

M'KEAN MAFFITT

Retired Sup't of Water & Sewage Wks.
WILMINGTON, N. C.

THERE has been much discussion in recent times about the fact that the elected officials of the town or city did not always understand the conditions existing, mainly because they did not talk the same language as the operator or superintendent. A case in point is illustrated by the delay that we once suffered in the case of a split 12" water main at the bottom of a long and quite steep hill. In this case it was necessary to cut off the water from the main for a distance of 1600 feet. The break was at the bottom of the hill and it was necessary to drain all of the pipe through the break. Naturally this took considerable time to empty the pipe, particularly as we had nothing but 10 quart buckets, and not enough of them, with which to handle the water. Then the valves did not hold any too well and there was considerable continuous run of leakage water. The mayor lived in the area that was cut off and he was considerably worried because he had no water for breakfast. When he came out of his house which was directly in front of the break he informed us that he wanted the water turned on by the time he came home for lunch. But, when he came home for lunch we were still dipping water out of the hole that had been washed in the street. We didn't have to dig to get to the pipe because the macadam pavement that had been on the street was in the hole, and the rush of water had used the larger stones as a cutting medium and the entire length of 12" pipe was exposed. It just happened that there was one 4" valve that had not been closed quite as tight as it might have been. So, when Mr. Mayor returned for lunch and found that we were still dipping water with buckets he inquired as to why we did not have trench pumps with which to handle the water. I told him that the reason why was that he had refused to approve the purchase of such pumps. He immediately gave his consent and told me to get two of them immediately.

I gave the signal to one of the pipe workers and he started to close the 4" valve and the teamster was sent to the supply store for the pumps. When "His Honor" returned home after a hard day's work in the office, we had finished the repairs, had the water turned on and were filling the hole. The trench pumps along with the partially unclosed valve had turned the trick. We had now talked to *one* elected official in language that he understood, so we got all the tools that we needed with which to make a quick repair.

The Author
Hon. Member A.W.W.A.

This is one of a series of "short-stories" by a Water Works Super, who claims that he learned all that he know about the Water Works Business "the hard way."

For many years we have known M'Kean Maffitt and have many times had the privilege of hearing him discuss water works problems at meetings, conventions, and elsewhere.

We have frequently listened with much pleasure to the philosophy and reasoning of the author, as expressed on the floor of water works meetings and privately. And, we have heard him "preach" a lot of common sense to the younger men and newcomers in the water works business.

We have admired his counselling and his long-time leadership in the North Carolina Section of A.W.W.A., of which he was a founder.

Listen to the Man Who Handles the Tools

I learned that it is sometimes advisable to take the advice of the man who handles the tools. Maybe he is a colored man, maybe he is a typical pipe worker, crude and uneducated but observant, but he sometimes knows the answer when the "boss" does not.

We had a 4" connection to one of the old time water-power hydraulic elevators. If you have never had one of these things to contend with you have something to live for. They are, or were, terrible institutions. In working on them you learned patience, cussing, and other things. In this case it was decided to use a water meter instead of a foot travel indicator since the foot travel indicator did not measure the leakage which was almost always more than the proper usage of water. Since the pipe force of the department did not have the proper tools with which to make a cut in 4" W. I. pipe the superintendent decided to let the job out to a contracting firm. My brother and I both advised against this but we were just boys, in fact as well as in experience, so the contractor was put on the job. The piping arrangement was such that it was dangerous to disturb the line in any way. There was a valve on the vertical section of the pipe that ran from the incoming service line to the pipe that ran underground in the basement to the hydraulic cylinder of the elevator. There was also a valve at or near the main. The ell at the top of the vertical run was screwed onto a short nipple that was caulked into the end of the B&S pipe that came from the main to the house line. This short nipple had a plain end, no bead nor thread. Nothing with which to hold the joint in the bell. The valve at the main was an open-left valve—one of the only two such valves in the distribution system. I knew this was a left hand valve but the superintendent did not. He thought that as all the other valves in the system were open-right valves this one also was open-right. Herein he made another mistake.

When the contractor's worker cut the under-floor section of the 4" W.I. pipe so that he could set the meter he endeavored to remove the cut out section by the us of chain tongs. In some manner, when he turned the cut piece he also swung the vertical section in such manner that he caused the

leaded joint where the W.I. and the C.I. pipes joined to turn. This weakened the joint in such manner that when the cut out piece finally was removed from the pipe line the nipple and the ell, along with the vertical run in which the house valve was located, were all forced off the pipe line and there was a 4" stream of water discharging into the basement. Sadly, the basement was almost full of dry goods still in the packing cases that they had been shipped in. A call to the water-works office immediately brought help, but the superintendent was along too. When we reached the street valve, which was in a valve-box made from a short length of 12" C.I. pipe with a heavy cap on it, he ordered the pipe worker to close the valve as if it were an open-right valve. I spoke up and told the worker to turn the other way; but the superintendent balled me out and told me to keep out of the things that I did not know anything about. I made an attempt to tell him that I knew it was a left-hand valve, but he threatened to fire me if I didn't keep out of it. By that time the valve stem was twisted off just above the shoulder that holds it in place. All the time the water was running in the basement doing more and more damage. Since it was then necessary, we had to dig out the valve box so that we could get to the valve and turn the stem with a pipe wrench. It happened that the superintendent then looked at the broken piece of stem with the head nut still on it. He saw that it was a left handed valve and, also, that it would be impossible to use a wrench on the remainder of the stem. Then he ordered the water shut off for the entire town while we plugged the hole in the basement. All we had to do to shut off the water was to close the stand pipe branch valve and stop the pumps, because this break was in that section of the line that had one valve at the pumping station and one at the stand pipe, with no chance of getting water to town in any other manner. We had a woodworking plant turn out an 18" long white pine plug 4¼" in diameter at one end and 3½" in diameter at the other end. This was driven into the bell end of the 4" C.I. pipe where it came through the wall of the basement and the water was turned on. The plug held and we now had a chance to stop and think, and to plan the next step. Of course this was to dry the basement, estimate the damage and then to get the broken street valve back in working order.

We finished the basement work after several days of terribly cold weather which almost killed us. Since we had to go into the basement, into the water and then at times come outside we almost froze to death. My legs got so cold I could hardly walk, but the "super," not being a drinking man (which at times is a rather bad position to be in, ordered one half pint of whiskey for the seven men I had in the basement. The first man who got hold of the bottle drank all of the whiskey and then there was none. I requested that the superintendent buy a gallon to start with, which he finally did, and that lasted only a few hours. We repaired the street valve, pumped out the basement, set the meter and carried the tools that the contractor's man had left behind to our own tool room, paid the damages which amounted to about $3,500.00 and called it a day, but it had actually been a week.

A "Hu-matic" Valve Closing Arrangement

We had an arrangement whereby fire pressure was raised every time there was a fire alarm. The standpipe was connected to the distribution system by a 12" main, with just *one* valve on it. If this valve gave trouble, which praise be it never did, we would have had to drain the standpipe, shut off the water from the entire town and then make the repairs. To be able to get this valve closed in time to get sufficient pressure for fire fighting it was necessary to have some one on duty all the time. The result was that my brother, the bookkeeper and I slept in a bedroom at the rear of the water-works office in the City Hall. In case of a fire alarm we had to dress, run to the stand pipe, two blocks away, and close the 12" single wedge gate valve on the stand pipe branch line so the engineer could raise his pressure to the required amount. This was a very dangerous arrangement and caused several breaks in the distribution system, one of which was that recounted earlier when we bought the two trench pumps. Another one will be described later. In closing this valve if the engineer at the plant raised his pressure too soon it was necessary to exert a great effort to get the valve all the way down. This effort was too much for one person, but it mattered not, the valve had to be closed. In doing this one night, when he was the first man on the job, my brother tore a ligament in his shoulder which finally resulted in his death. But that is another story. *(To be continued.)*

George Flower Cleveland's New Commissioner

Mayor Thomas A. Burke of Cleveland, Ohio, has appointed George E. Flower to the post of Commissioner

of Sewage Disposal, succeeding the late Joseph W. Ellms who had this post for a number of years.

The appointment was a career appointment of Mr. Flower, who for the past 21 years has been Superintendent of the Southerly Treatment Plant of Cleveland. Mr. Flower had been in the service of Cleveland for 35 years, his first job being assistant engineer during construction of Cleveland's first filtration plant and 11 years total service with the Water Department. He transferred to the Southerly Sewage Treatment Plant 24 years ago as assistant superintendent, becoming superintendent 3 years thereafter.

Mr. Flower is a registered Professional Engineer and member of several professional and engineering societies. He attended Ohio State Univ. and the South Dakota School of Mines and was graduated with the B. S. degree in Chemical and Metallurgical Engineering. He is a past president of the Ohio Conference on Sewage Treatment and Trade Wastes Disposal.

De Laval Engineering Handbook

The De Laval Steam Turbine Co., Trenton 2, N.J., has just issued a revised edition of its "De Laval Engineering Handbook." The book contains seven sections devoted to general information, Steam Turbines, Centrifugal Pumps, Imo Pumps, Centrifugal Compressors, Helical Reduction Gears and Worm Reduction Gears. The book is a handbook of reference data information and formulas compiled by the De Laval Steam Turbine Co. to facilitate the work of power plant, industrial and design engineers.

The book was edited by Austin H. Church and Hans Gartmann and may be obtained from the De Laval Steam Turbine Co., Trenton 2, N.J., for $2.00 a copy.

MOBILE LIGHTWEIGHT SERVICE TRENCHER

Pays Its Way in Richmond Service

by

H. E. LORDLEY

Assistant Director

DEPT. OF PUBLIC UTILITIES

RICHMOND, VA.

IN earlier times of cheaper labor the most economical system of cutting service trenches was the familiar "pick and shovel" method. Today, with high labor costs, management must investigate every possible mechanization method to reduce the cost of construction of mains and services. The American Gas Association as early as 1946 recognized the need for lightweight trenchers, and by 1948 six manufacturers were producing this type of equipment.

The Department of Public Utilities of the City of Richmond is different from most municipalities, since we operate both the gas and water systems. We are, therefore, required to cut both water and gas service trenches from the main in the street to the building. For several years Cleveland Baby Digger has been used for cutting service trenches. While

The Author

this is an excellent machine for work in new subdivisions, it lacks the necessary mobility to cut individual services at scattered points throughout the city.

In 1948, our installation crews were unable to meet the demand for new services and the Department was confronted with the problem of hiring and training additional crews or the purchase of additional mechanical equipment for use by the existing crews. It was decided to purchase a lightweight trencher that could move from district to district under its own power and yet require the minimum capital investment. The least expensive lightweight mobile trencher available was the Willys Jeep with the "Jeep-A-Trench" attachment, selling for about $4,000.

The "Jeep-A-Trench" was developed and manufactured by the Auburn Machine Works, Inc. of Auburn, Nebraska, utilizing the Willys Civilian Jeep as the power unit. The familiar Jeep of war days was selected as the power unit to give the purchaser the advantage of volume vehicle production and ready availability of parts. The actual trencher attachment is driven with a power take-off. A gear reduction

Light Weight Service Trencher in Action

Operator has hand on depth control wheel. Note screw-conveyor depositing dirt on both sides of trench.

to the wheels makes it possible to operate the machine at a very slow speed of forward movement, controlled by the operator from zero to 300 feet per hour.

The unit used in Richmond will cut a trench 16 inches wide and up to 5 feet deep. Other units can be purchased for a trench width of only 6 inches, which reduces the quantity of backfill and keeps pavement replacement costs to a minimum. The operator controls the depth of cut by means of a large hand wheel on the left side of the Jeep. A screw conveyor deposits dirt on both sides of the trench, leaving space for the workmen and making backfilling easy. Shear pins are provided to protect the equipment from damage due to overload. A winch is available, as an extra, to furnish additional propulsion in extremely muddy conditions. However, this has not been required on our unit.

In addition to gas and water services, the Jeep can be used to cut trenches for cable, farm tiling projects, and test holes for the location of mains, making the unit attractive to the smaller communities as well as the larger.

Maintenance has been higher on this lightweight unit than on the more rugged trenchers, but this can be reduced by a program of preventive maintenance and intelligent operation.

One of the photographs pictures a job on a street having a penetration treated gravel surface. If required, greater width of trench over the main is procured by making a second cut for a short distance.

The "Jeep-A-Trench" Ready to Go

The unit is small and can operate without difficulty in close proximity to fixed objects such as houses, trees and curbs. Our experience in Richmond with the "Jeep-A-Trencher" has justified the expenditure for the unit which fills the need for a mobile lightweight trencher for those jobs in which the "pick and shovel" method is too slow and expensive and the use of the larger more expensive trenchers would be cumbersome and more expensive.

This is "Ed" Cleary

(A Correction)

We imagine quite a number of our readers exclaimed "Says Who?" when seeing the picture of "The Author"

Edw. J. Cleary

which appeared with the article "Industry and Pollution Abatement" by Edw. J. Cleary, Exec. Director of the Ohio Valley Water Sanitation Comm., on page 119 of our March issue.

The explanation lies in the fact that we give our make-up department the number of the cut of an author when we already have a cut in the files. Seldom is a mistake ever made but this time the correct number 3336 was garbled and cut number 3363 was pulled.

For the benefit of those who may wish to see what "Ed" Cleary really looks like, his cut is being used with this correction.

J. W. Johnson New Gen. Mgr. Buffalo Sewer Authority

John W. Johnson, until recently Supt. of Sewage Treatment, Buffalo Sewer Authority, Buffalo, N.Y. has been appointed General Manager of the Authority to fill the vacancy left by the resignation of Frederick W. Crane to become Commissioner of Public Works in Buffalo.

A graduate civil engineer of Cornell University, Mr. Johnson first was associated with the Johnson Construction Co. in Buffalo and was subsequently engineer, superintendent and superintendent of construction on several commercial and institutional projects.

In 1936 Mr. Johnson joined the Buffalo Sewer Authority as Construction Engineer during the installation of the interceptors and treatment works. In 1938, he became Asst. Supt. of Sewage Treatment Works and in 1942, he was appointed Superintendent when Charles R. Velzy resigned to enter

the consulting engineering field in New York.

Mr. Johnson who was appointed General Manager on Feb. 8, was elected President of the N.Y. Sewage and Industrial Waste Assn. at its annual meeting in January. He is also a member of ASCE, and NSPE in which he has also been active in Erie County as president of that chapter. Mr. Johnson has authored several papers on the operation of the Buffalo Treatment Works.

FUNDAMENTALS OF CORROSION AND ITS MITIGATION*

Part III—Methods of Mitigating Corrosion

by

E. W. MOORE[1], W. H. SEARS[2], AND L. RUBIN[3]

N.E.W.W.A. COMMITTEE ON CORROSION

PARTS I and II of this report have appeared in the previous issue of *Water & Sewage Works*. The first part presented fundamental definitions, and the second part covered fundamental reactions in corrosion phenomena. Part III herewith summarizes present knowledge of how to combat corrosion with particular reference to water systems.

III. METHODS OF MITIGATION OF CORROSION

A. Self-Corrosion

SELF-corrosion is that resulting from the inherent tendency of all metals to dissolve in water, aqueous solutions of water-soluble materials, or mixtures of water with some other substance which is neither soluble in nor a solvent for water. It is known as electro-chemical corrosion and is the type of corrosion commonly found in piping systems. This discussion applies primarily to water systems. Self-corrosion may be mitigated by

(1) Selection of materials
(2) The use of protective coatings
(3) Treatment of the water

These topics are treated below.

1. **Selection of Materials.** Pipe may be non-metallic and there are many varieties of such pipe available. For the waterworks industry, however, only asbestos-cement pipe, concrete pipe (and masonry conduits), and wooden pipes are at present suitable and practicable. Of these, wooden pipe is now used only as wood stave pipe and its use in the eastern section of the country is practically non-existent except in some waterpower developments.

Asbestos-cement pipe withstands salt water and soft and corrosive waters, but not acids. It is available for mains only and for such use is an important competitor of metallic pipe. It has been found to increase the alkalinity and hardness of water when first installed, an effect which gradually diminishes but may persist for six months or more. Recent methods of manufacture have greatly reduced this leaching characteristic. The *N.E.W.W.A. Journal*, Vol. 51, No. 3 (September 1937), contains a series of papers on the manufacture, laying, and use of asbestos-cement pipe.

Concrete pipe is increasingly used for large mains. The present outstanding example of the use of pipe of this type is the Hultman Aqueduct of the Boston Metropolitan Supply, described in detail in the *N.E.W.W.A. Journal* for September 1941, page 315.

For service connections and interior and other small piping, there are available pipes of various corrosion-resistant metals such as copper, brass, lead, tin, monel, stainless steel, silicon bronze, nickel-molybdenum-chromium-iron alloys, and others.

Copper is highly resistant to corrosion, but for very soft waters containing large amounts of carbon dioxide, tin-lined copper is to be preferred.

Brass pipe containing 85 per cent or more of copper (red brass) is highly resistant to corrosion. Brass pipe containing 60 per cent or less of copper will dezincify in soft waters; 67 per cent copper (alpha) brass is fairly resistant. Green stains and precipitates may appear when copper or brass pipe is used with very soft waters containing large amounts of carbon dioxide.

Lead pipe should never be used with soft waters because of the toxicity of lead salts. It is suitable for hard waters.

The other corrosion-resistant materials noted above are in general too expensive for use as water pipes and are used mostly in special work, though silicon bronze is used extensively in sewage plants, especially for valves, sluice gates, and stop shutters.

2. **Protective Coatings.** "When pipe material is subjected to corrosive conditions to which it is susceptible, some form of protective coating may be more economical than resorting to a more resistant but more expensive material. Since corrosion may arise from the fluid conveyed by the pipe, from the atmosphere, or from the soil environment in the case of a buried pipe, protection may be needed either internally or externally, or both, depending on circumstances. In the case of internal attack, it may be possible to reduce the corrosive nature of the fluid conveyed."*

Protective coatings and linings for ferrous pipes, valves, and fittings may be (a) non-metallic or (b) metallic.

a. The NON-METALLIC COATINGS most commonly used are paints, asphaltic or bituminous materials, and cement. For special purposes, such as the handling of chlorine and chlorine compounds, rubber-lined pipe is also available.

(i) Paints, while effective against atmospheric corrosion, are less so against under-water and underground corrosion. Therefore they are seldom used for underground pipes but rather for ferrous valves and for submerged steel structures where galvanizing is not practicable or the expense of galvanizing is not warranted. Paints commonly used in waterworks equipment, especially that subjected to submergence or damp atmosphere, have asphaltic or bituminous bases often applied over a base coat of red lead.

(ii) Asphaltic or bituminous linings and coatings are made from natural asphalt or coal-tar pitch. They are applied hot by dipping or by spinning. The A.W.W.A. standard specifications for cast-iron water pipe and fittings cover in detail the approved practices of coating cast-iron pipe with hot coal-tar pitch varnish by dipping. In waterworks practice no other coating is normally applied to cast-iron pipes.

Steel pipe with its greater susceptibility to corrosion and its lesser thickness as compared with cast-iron pipe requires, in general, more attention to coating, especially the external coating of submerged or buried pipes. For steel water mains the A.W.W.A. has

*Report of the Committee on Developments in Our Knowledge of Corrosion and Its Mitigation presented at the Annual Meeting of the N.E.W.W.A. in 1949. Published here by permission of the Association.

1) Assoc. Prof. of San. Engr., Harvard University and Chairman of the Committee.

2) Mech. Engr., Metr. Dist. Water Supply Comm., Boston, Mass.

3) Chief of Labs., Water and Sewage Laboratories, Mass. State Dept. of Health, Boston, Mass.

*"Piping Handbook" by Sabin Crocker.

formulated specifications for coal-tar enameled coatings (AWWA 7A.5 and 7A.6).

The corrosion protection provided under these specifications is as follows:

For the inside of all steel pipe, a coat of coal-tar primer followed by a hot coat of coal-tar enamel applied either by manual or by mechanical means.

For the outside of pipe, 30 inches and over to be placed underground, a coat of coal-tar primer followed by a hot coat of coal-tar enamel and one coat of water-resistant whitewash.

For the outside of steel pipe smaller than 30 inches to be placed underground, a coat of coal-tar primer followed by a hot coat of coal-tar enamel into which is bonded an asbestos felt wrapper, with a finish coat of kraft paper or one coat of water-resistant whitewash.

For the outside of all steel pipe to be placed above ground exposed to the weather, two coats of synthetic red lead primer (or one coat of synthetic red lead primer and one coat of synthetic white enamel) and one coat of aluminum paint.

(iii) Cement linings or coatings. Cement-lined ferrous pipe and fittings, both cast-iron and steel, are used extensively in New England. The A.W.W.A. has prepared specifications (AWWA 7A.7) for "Cement-mortar Protective Coating for Steel Water Pipe 30 inches and over" and a similar specification for cast-iron pipe. Cement-lined pipe, both steel and cast-iron, conforming thereto are commercially available. Mains may also be lined in place by patented processes. Cement linings have the same temporary effect on quality of water when first installed as has asbestos-cement pipe. A cement lining is not wholly impervious to water, but water that penetrates forms an alkaline solution in contact with the iron and tends to inhibit corrosion. Water of low pH value, however, continually reacts with the coating so that cement-lined pipe is not suitable for highly acid waters.

b. *Metal coatings of ferrous pipe.* Of the various metallic coatings and linings available, the most commonly used in waterworks are zinc and lead.

Hot-dip galvanizing is the simplest and commonest method of applying zinc to steel pipe, and the use of pipe galvanized by this method is widespread in interior piping, service connections, and to a limited extent in small mains. Galvanizing provides reasonably good protection against atmospheric corrosion, but it is a poor type of protection with some waters. Zinc is protective because it is anodic with respect to iron and it is intended to be consumed by corrosion. Too long life should not be expected of it. ASTM specification A 120-44 covers hot-dipped zinc-coated steel pipe.

Lead-lined pipe and fittings are suitable for sea water and weak acids but should never be used with soft domestic waters because of toxicity. Since lead is cathodic with respect to iron, a lead lining must be continuous, eliminating any access of the liquid to the iron. This necessitates the use of flanged joints with the lead lining turned back over the face of the flange.

Other metallic linings and coatings are available, but in general they are used mainly for protection against atmospheric corrosion and their value for water pipe and fittings is doubtful. They may be listed briefly here. *Aluminum* may be applied by "calorizing," a process similar to Sherardizing. *Copper, nickel, chromium,* and *cadmium* may be applied by electroplating. There are also processes or treatments which alter the surface of the iron (such as Parkerizing, Bonderizing, anodizing, etc.) and produce moderately corrosion-resistant films of iron oxides or phosphates on the surface.

c. *Natural protective coatings.* Under certain conditions mineral coatings, coatings formed by corrosion products, and by those formed by organic slime, appear to act as corrosion inhibitors. Deposits of mineral coatings of calcium carbonate or of silicates, due to the presence of those substances in the water, may occur to retard corrosion, and this phenomenon explains the lower corrosiveness of hard waters. Oxides, hydroxides, carbonates, basic carbonates, silicates, etc., of the metals, formed by reaction of dissolved metals with substances in the water may form coatings which cause a decrease in the rate of corrosion and may ultimately stop it almost completely. Organic slimes also retard corrosion, a fact accounting partly for the observation that filtered waters are often more corrosive than unfiltered.

3. **Mitigation of Corrosion by Treatment of Water.** There are a number of methods of altering the composition of water so that its corrosive attack on metals is diminished; on analysis, most of these can be classified under one or more of the following groups:

a. *Treatments that reduce the hydrogen-ion concentration of the water.* This covers the use of the ordinary alkaline agents such as soda ash and caustic soda.

b. *Treatments that induce deposition of mineral films on the metal.* This includes treatments to produce calcium carbonate saturation, treatments with silicates, and probably also the treatments with complex phosphates.

c. *Treatments with organic corrosion inhibitors.* These substances deposit organic protective films on the metal; they include an enormous range of compounds, from glue to complex amines.

d. *Treatment with passivating agents.* These are strong oxidizing agents that convert the metal surface to an impervious oxide film.

e. *Treatments to remove dissolved gases, principally dissolved oxygen, secondarily carbon dioxide.*

Items c and d are not applicable as yet to the treatment of drinking water, since the substances used are toxic or otherwise objectionable and yet must be used in moderately large quantity to be effective. Item e is rarely employed in waterworks practice because of technical difficulties, although removal of carbon dioxide by aeration is sometimes practiced as an anti-corrosion measure. In this case its value is dubious, since the oxygen added may be much worse than the carbon dioxide removed. Carbon dioxide is also destroyed in process a. This leaves us with items a and b as our main reliances in corrective treatment of water.

4. **Applications of Methods.** In practice it is often difficult to separate and evaluate methods a and b, since in many waters treatment with alkaline reagents of any sort will produce supersaturation of the water with calcium carbonate, calcium silicate, or a number of other similar compounds capable of acting as protective films. However, in many of the soft waters of New England the separation is very well defined, since the content of calcium is such that no reasonable amount of treatment with the sodium alkalies will produce supersaturation with calcium salts. In this case the two types of treatment can be discussed separately.

a. *Treatment to reduce the hydrogen-ion concentration or to raise the pH value.* This type of treatment has as its objective the slowing of *Step II* in the corrosion chain by making hydrogen ions less available. As previously noted in the theoretical discussion, this procedure is relatively ineffective in the pH zone from 4.5 to 10.0, which covers most natural and treated waters.

The chemicals used in practice are principally soda ash and caustic soda, which are added in amounts sufficient

to produce a desired pH value. The statement above regarding the pH zones in which such treatment is effective has been confirmed by the experience of many New England waterworks operators, who have had little success with this type of treatment. It is much more successful in harder waters, but here it succeeds through the combination of the alkaline agents with the calcium of the water to produce protective films.

b. *Treatment to produce deposition of mineral films.*

(i) *Calcium carbonate films.* Water treated so as to produce a condition of saturation or near-saturation with calcium carbonate shows a great decrease in its ability to attack metals, although the attack is not entirely eliminated. The reduction is due to the tendency of the water to deposit, on the metal, films composed in part of calcium carbonate, and in part of carbonates of the metal itself. The type of treatment required to produce a condition of saturation varies with the composition of the water. Hard waters may require only the addition of soda ash; soft waters with moderate amounts of alkalinity will require only lime, but soft waters of very low alkalinity may need both.

The quantitative relationships involved in such treatments were developed originally by Langelier *(Jour. Amer. Water Works Assn. 25,* 1500, 1936) and extended by him and others (Moore, *Jour. New England Water Works Assn. 52,* 311, 1938; Hoover, *Jour. Amer. Water Works Assn. 30,* 1802, 1938; Langelier, ibid. *38,* 169, 1946) to allow calculation, from the analysis of the water, of the chemicals needed for treatment. Previous to Langelier's work, Baylis had shown how the treatment required could be determined by testing treated samples against calcium carbonates; this is the so-called "marble test," adapted by Enslow for continuous operation with his stability indicator.

While the protection against corrosion afforded by treatment of water to calcium carbonate saturation is not absolute, it is still the most widely used method of controlling corrosion by water treatment. The chemicals used are relatively inexpensive and are already familiar to the waterworks operator through their other applications in waterworks practice. There are few problems involved in dosing, and under- or over-dosing for short periods has little noticeable effect.

(ii) *Silicate films.* The addition of soluble silicates (principally sodium silicate) to water in sufficient quantities will produce incipient precipitation of calcium silicate or of silicates of the metals in contact with the water. The metals will tend to become coated with silicate films, which appear to provide good protection. Not so much is known of the quantitative relationships involved in silicate film formation as in the formation of carbonate films. However, there are numerous instances of successful treatment with silicates in which dosage has been determined by experience. Dosing involves no great problems; the silicates are physiologically harmless and the quantities required are small.

(iii) *Polyphosphate films.* The complex glass-like sodium phosphates—so-called meta- and pyro-phosphates—are a comparatively new discovery in anti-corrosion treatment. When added to water in relatively small quantities, under proper conditions, there is no doubt that they will materially reduce the rate of attack on ferrous metals. The presence on the metal of a film, only a few molecules thick, of phosphate-containing material, is demonstrated by the appearance of "interference colors." At present this film is believed to consist of compounds of the polyphosphates with the metal or with calcium from the water. The polyphosphates are relatively expensive per pound, but the smallness of the dose required allows them to compete favorably with the anti-corrosion treatments mentioned previously. The treatment is simple in application, involves less increase in the mineral solids of the water than other methods, and has as a consequence been widely adopted during the past few years. In beginning polyphosphate treatment on old, heavily incrusted piping systems, difficulty has occasionally been experienced through the tendency of the polyphosphates to strip off the old deposits and disperse them in the water. Some care is required in the initial application to avoid complaints of turbid or red water.

B. Galvanic Action

As stated in Section II of this report, there is a tendency for each metal to release ions to the water in which it is immersed, and this tendency is different for the different metals. This solution pressure may be expressed in terms of electrical voltage. As already noted, the metals may be arranged in a table in order of decreasing solution pressure. Such a table is referred to as the "electrochemical" or "electromotive" series of the elements. The following series includes the metals commonly encountered in the waterworks field.

Electrochemical Series of the Elements

Aluminum
Chromium
Zinc
Iron
Nickel
Tin
Lead
Hydrogen
Copper
Silver

When two dissimilar metals in contact with each other are immersed in water, the metal that stands higher in the series will tend to release metal ions to the solution, while hydrogen will be formed on the one lower in the series. With reference to the nomenclature used in Section II, the anodic reaction occurs on the metal higher in the series, and the cathodic reaction on the one lower in the series. This results in a flow of current through the solution from the point where the metal is going into solution to the point where hydrogen is being plated out and a similar flow of current in the opposite direction across the junction of the two metals. The metal higher in the series undergoes rapid corrosion, while the corrosion rate of the metal lower in the series is negligible. The entire process is spoken of as "galvanic action." The steps in the process are influenced by the same factors that were described in Section II-A for ordinary corrosion. The extent of galvanic action is also influenced by the difference in potential between the two metals undergoing corrosion and by the relative area of the two metals. If the area of the metal lower in the series (the cathodic area) is large compared with the anodic area, corrosion will be more extensive because there is a large area available for the discharge of the hydrogen that is formed. The extent of galvanic action is also influenced by the conductivity of the solution. In the case of soft waters of very low mineral content and therefore low conductivity, galvanic action will occur only over an area of an inch or so on either side of the junction of the dissimilar metals. With waters of high mineral content, the area of activity may extend somewhat farther.

The solution potential of alloys differs from that of pure metals, and even the processing of a metal will change the electrochemical potential of the section of metal processed. The oxides of a metal likewise have a different solution potential from the original metal. Thus mill scale has a different potential from the iron of the pipe. For these reasons, and because the use of dissimilar metals is quite common in piping systems, galvanic corrosion is quite common. However, as previously stated, the

effects of galvanic action are usually limited to a small area in the vicinity of the junction of the dissimilar metals and the extent of galvanic action is minimized by all of the various factors that were pointed out under the discussion of corrosion.

Galvanic action can be kept at a minimum by using the same metal as far as possible throughout the piping system. For example, the use of brass faucets, bronze valve bodies, and brass or bronze fittings with iron piping should be avoided. Where dissimilar metals are absolutely necessary, the choice should be metals as near together in the electromotive series as possible. There have been attempts to reduce the effects of galvanic action by the insertion of a short section of nonconducting piping, such as plastic or hard-rubber piping, between sections of dissimilar metal piping. This procedure will eliminate galvanic action, but it adds materially to the cost and complexity of installation.

C. Stray Current Electrolysis

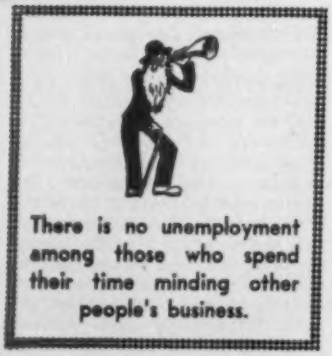
Stray electric currents may produce corrosion in underground pipes. Under normal conditions only direct currents will produce such corrosion. In a direct-current railway system and in the distribution of direct-current electricity, one side of the system is grounded. If there are defective grounds or defective bonding of the rails of streetcar lines, some current will find its way back to the substation or power station through the earth, and in seeking the path of least resistance current may enter an underground pipe at one point and leave it again at another. Since the pipe at the points or areas where such stray currents leave the pipe is anodic to the earth, corrosion will occur at those points. It may be severe. The remedies consist of providing more direct paths—paths of lower resistance—back to the station. Among these remedies the following may be noted: (a) for streetcar systems—the use of a two-trolley system, thorough bonding of the rails, the use of heavy pipe covering to serve as an insulator in the vicinity of the substation or power plant, insulation of the pipe joints, and the use of drain cables to take the current off the pipe; (b) for ground connections to water pipes—careful checking of all grounds of electric, telephone, and radio systems to see that they have no potential and therefore carry no current.

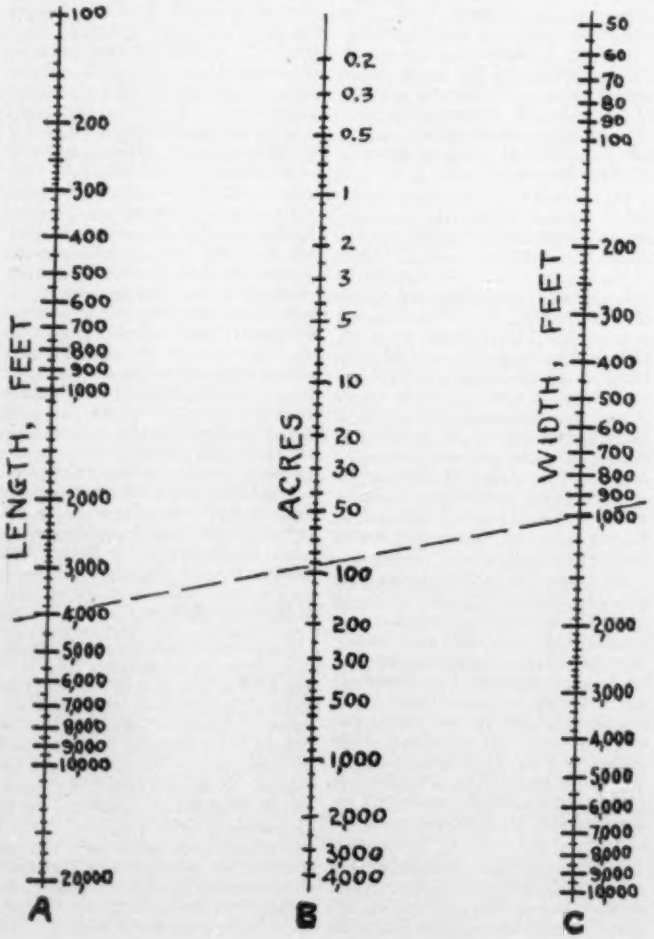
How Many Acres in Plot of Ground*

Several years ago this writer prepared a chart similar to this one. It dealt with "How Many Acres?", and was enthusiastically received, but many readers objected to it because it was limited to 40 acres. They inquired, "Can't you give us a chart that will take care of more acres?" So, the chart herewith is the result. This chart goes to 4,000 acres, column B, as you will note, and is therefore 100 times larger than the former chart.

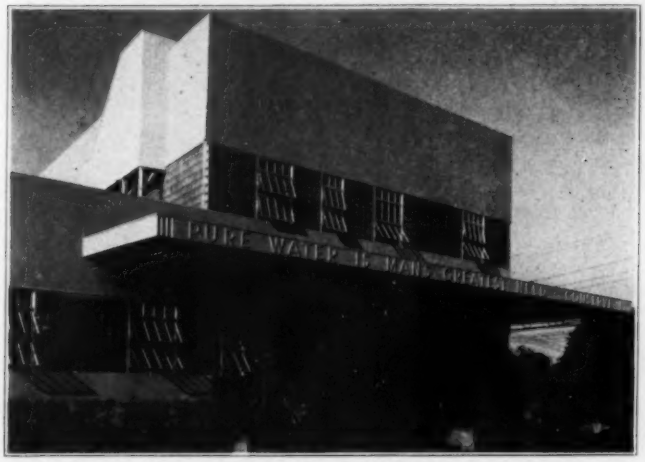
To use the chart simply run a straight line across connecting the length with the width, and the intersection with the middle column gives the number of acres. Thus for example the dotted line across this chart shows that if the length of the field is 4,000 ft., column A, and the width 1,000 ft., column C, the area is 90 acres, column B. This chart includes areas all the way from 0.2 of an acre to 4,000 acres.

*Contributed by W. F. Schaphorst, M.E., Newark, N.J.





HONOLULU'S WATER SUPPLY



Offices of the Honolulu Board of Water Supply

THE people of Honolulu, like the people of most other cities, take their water supply for granted, but if they could see below the surface their casualness would change to wonder and admiration.

The fact that this city of 280,000, capital of the Territory of Hawaii, can exist at all is due to a combination of nature's beneficence and man's ingenuity.

To appreciate this fact, one must know a little about the geography of Oahu, the island upon which Honolulu is situated.

Honolulu's front yard is the Pacific ocean; her backyard is the Koolau Mountain range, lying four or five miles behind the city. The trade winds that sweep in from the sea drop part of their moisture in the form of rain when they strike the cooler air of the mountain area.

Oahu is of volcanic origin, having come into existence, according to geological estimates, from two to five million years ago. Because of this, much of the rock strata is porous, and a large part of the rainfall is absorbed by it. The water flows underground through this sponge-like rock until it finds its way beneath the city.

Honolulu stands on caprock, which is a thick layer of watertight soil. This forms a subterranean basin which traps the water and confines it. Because of the constant flow from the mountains, sufficient pressure is created to force it to the surface through artesian wells bored through the caprock.

Salt water from the ocean also seeps into the porous rock beneath the caprock, but, being heavier, it stays on the bottom while the fresh water "floats" above it. It is estimated the fresh water extends down about 1000 feet before the salt water is reached.

Approximately 55 per cent of the water produced by the city supply system comes from 25 artesian wells. They are from 200 to 600 feet deep. The water is forced through mains and into the reservoirs by three steam-operated pumping stations. They pump about 20,000,000 gal. each day.

It is the combination of these three natural conditions — moisture-laden trade winds, the mountains to catch the rain, and the peculiar geological formation of Oahu—that makes the water supply system possible. Without any one of them, Honolulu literally could not exist. Engineers say that as far as they know, Honolulu is the only city in the world that gets its water in such a way.

Until recent years, Honolulu had been able to rely on the deep artesian wells to bring the water to the surface. However, as the artesian head is lowered, there is increasing danger of the intrusion of salt water.

To overcome this, Honolulu has established three underground pumping stations which draw the water from the surface, rather than below it. The water is gathered in horizontal collection tunnels and is pumped up by electric pumps. They provide 15,000,000 gal. daily at present.

Frederick Ohrt, general manager and chief engineer of the Board of Water Supply, feels that deep artesian wells are on their way out and that they will ultimately be succeeded by underground pumping stations.

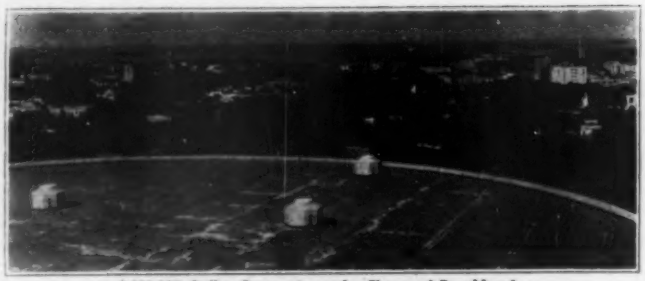
One of Honolulu's Three Underground Pumping Stations

In addition to the wells and pumping stations, some water is brought to the city by high-level mountain tunnels. The amount is relatively small, however, totaling only about 1,500,000 gal. daily on the average.

Some industrial firms have developed their own artesian wells which produce about 14,000,000 gal. daily.

The total water consumption, including all sources, is about 50,000,000 gal. every 24 hours.

Before the development of artesian wells, little grew on the island of Oahu except in the few areas fed by mountain streams. Today, Oahu boasts four great sugar plantations, producing about 200,000 tons of sugar annually. Pineapples and other crops flourish. The island is now a place of great beauty and productiveness.



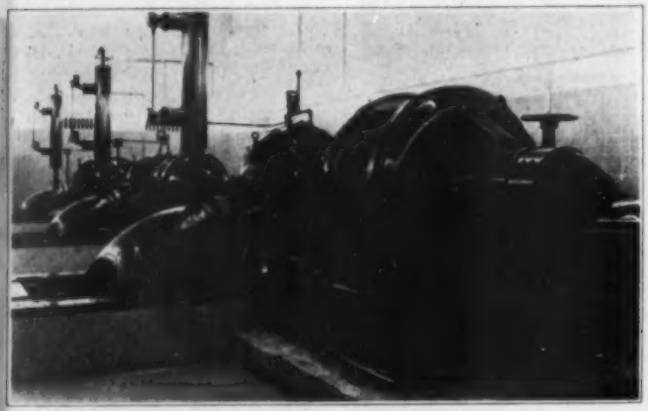
2,000,000 Gallon Reservoir on the Slopes of Punchbowl—An Extinct Volcano and Famed Landmark
(Honolulu is in the background)

Honolulu's public water system operates under the Board of Water Supply, a body composed of seven commissioners, two of whom are ex-officio members.

By law the system is self-supporting, collecting no funds from tax sources. The Board fixes rates and may issue bonds to finance improvements.

Operating expenditures exceed $2,000,000 a year. The system represents an investment of about $20,000,000. In addition to the pumping stations, there are 26 equalizing reservoirs with a capacity of over 20,000,000 gal., 11 booster pumping stations, two aerators, over 350 miles of pipelines, 2500 hydrants and 29,000 meters. Employees total about 400.

People of Honolulu have a constant reminder of the primary importance of pure water to the Hawaiian community—on the side of each truck of the Board of Water Supply and over the doors of the Board's main offices appears the legend: "Pure Water, Man's Greatest Need."—*Otto Jensen.*



North Halawa Valley Underground Pumping Station

Michigan Section Sponsors Extension Courses

The education committee of the Michigan Section AWWA has been working on the continuation of its extension courses. Through the cooperation of the University of Michigan, Michigan State College and the State Bd. of Control for Vocational Education two new courses are being offered this year.

"Fresh Water Biology, Course II," started Mar. 1 at Ann Arbor. It consists of a 12 week term with 2½ hour periods each Wednesday night. This course is designed for persons with some previous knowledge of the technic of microscopy of water. Prof. Frank E. Eggleton, Univ. of Mich., is instructor and Walter Muhlitner, Ann Arbor Water Filtration Plant, is local chairman.

"Problems in Water Supply Engineering" started Feb. 13. Classes for this 12 week course (2¼ hours each Mon. night) are being held at the Rackham Bldg. in Detroit. George Hubbell of Hubbell, Roth, and Clark, is the instructor and Owen Dice, Springwells Water Plant, is local chairman. This course covers practical problems in the operation of a water system including supply, treatment, and distribution.

Michigan water works operators working for certification receive credit for educational requirements by their attendance at these meetings.

19th Arkansas Short School

On April 17-19 inclusive, the Arkansas Water and Sewage Conference will hold its 19th annual meeting and short school at Little Rock, Ark. The meeting will be under the auspices of the College of Engineering of the University of Arkansas and will be held in cooperation with the Southwest Section AWWA and the State Board of Health.

The program this year will include President A. H. Niles of the Federation of Sewage Works Assns., President Lewis Webster Jones of the University of Arkansas, and Governor Sid McMath of the State of Arkansas.

The sessions will be held in the Lecture Hall of the Municipal Auditorium and will include such topics as Wells, Surface Waters, Purification, Distribution, Pumping, Sewage and Sewage Treatment, and Metering.

Licensing examinations will be held at the end of the meeting. Chairman of the 1950 Conference is Neal B. Thayer of Jonesboro, and Secretary of the Conference is Dr. Harrison Hale, Fayetteville.

OPERATION AND MAINTENANCE OF WATER WELLS*

by

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THE value of efficient operation and maintenance of water wells is something that is too little appreciated in the business of supplying water from wells. In the first place, not too much is known about the subject, as no two wells react in the same way under similar operating conditions; and, secondly, it is not generally realized that efficient maintenance and operation is an important part of pumping water.

As a general thing more attention is given to the initial installation of pumping equipment than to the construction of the well itself, or to its subsequent operation and maintenance. As a matter of fact the operation and maintenance of water wells should not be included in the problems of pumping, but should be regarded as a separate problem directly related to ground water conditions and the questions arising in connection with well construction.

Dr. O. E. Meinzer, formerly chief of the Ground Water Division of the U. S. Geological Survey, once said: "The most urgent problems in water hydrology at the present are those relating to the rate at which rock formations will supply water to wells in specified areas, not during a day, a month, or a year, but permanently." While this statement was made with the problems of ground water supplies in mind, it also applies to the construction, operation, and maintenance of water wells.

In considering the subject we can immediately divide all water wells into two classes or groups, namely, shallow wells and deep wells, shallow wells being those which obtain their water from unconsolidated formations lying above the basal rock, and deep wells being those which obtain their water from the basal rock. The technique and method of well construction used in these two classes of wells is entirely different. Consequently, the problems connected with their operation and maintenance are partially dependent on the type of wells in use.

*A paper read before the 2nd Annual Penna. Water Works School, Penna. State College.

The Author

Shallow Wells

Shallow wells must depend on openings of some kind in their casings to let water into them, while deep wells depend on openings in the formation for their water supply. These openings in shallow wells vary from the open bottoms of well casings to all sorts of punched, perforated, sawed, and even burned openings—anything at all to let water into the well. By contrast, we have carefully designed well screens, whose openings are intended to serve two purposes, namely, to let water into the well and at the same time hold out the finer particles of the formation in which the screen is placed. Openings in well casings may or may not serve their purpose and for this reason many shallow well failures are due to poorly designed casing openings or inefficient well screens. There are other causes for well failures, but the three most common are as follows:

1. Failures due to the casing openings or screens becoming clogged, incrusted, or corroded. Such failures are indicated by increased drawdowns under pumping or by the continuous pumping of fine sand.
2. Failures due to pumping the ground-water reservoir at rates in excess of the rate of replenishment. Such failures are indicated by a cumulative lowering of the static and pumping levels in the well accompanied by a decrease in capacity.
3. Failures due to faulty initial well construction or to mechanical deterioration of the well during its life. Such failures are indicated by difficulty in setting and operating pumping equipment and by partial or total collapse of well casing, or by contamination of the water being pumped.

Before any one can properly operate or maintain a water well, he should have a working knowledge of the probable causes of well troubles and what can be done to eliminate them. In the well business we talk of the life of a well, just as we do the life of a human being. Like human beings, water wells live only so long, regardless of how well they are constructed and cared for during their lifetime. Fifty years is a long life for the average water well. Shallow wells are shorter lived than deep wells, but all of them fail sooner or later.

Relationship of Failures to Design, Operation and Maintenance

If now we take up the causes of water well failures as a means of understanding good operation and maintenance, let us consider the failures due to poorly designed openings in the well casing or screen, whichever is involved. Every operator of a water well should have some knowledge of the basic principles of incrustation and corrosion as these phenomena apply to water wells.

Corrosion of metals is a chemical action set up by the environment to which they are exposed, resulting in their deterioration or an eating away of the metal.

Incrustation, on the other hand, is an accumulation of mineral salts or other extraneous matter in and immediately behind the openings in a well casing.

These terms are frequently confused. We hear of openings being "corroded over" when it is meant that they are incrusted, and vice versa. As a matter of fact, corrosion of well screens is *not* as prevalent as incrustation, but it is more destructive, as the metal itself is destroyed. Without considerable experience and some investigation it is difficult to recognize the type of corrosion involved, since there are at least six different forms and the trouble may be due to any one of them.

Direct chemical corrosion is the most common form encountered in

the well business. It involves nothing but simple solution of the metal due to the chemical nature of the water. It is evidenced by a gradual enlarging of the well openings permitting the well to pump fine sand.

Dezincification of brass and graphitization of iron is another form of corrosion frequently encountered in water wells. It is the selective removal of an element from an alloy, such as the removal of zinc from a brass. When this form of corrosion occurs, the metal is left in its original form but is substantially weakened. Examination with a microscope will reveal the extent of structural change but it is practically impossible to make such an examination without removing the corroded parts. The result is, that this type of corrosion may be responsible for sudden failures of well casings or screens, and of pumping equipment that appears to be sound.

Intergranular corrosion is a localized chemical reaction at the boundaries of metallic crystals. It is an amalgamating action and very destructive. Fortunately, it is not often encountered in the well business. Furthermore, little can be done to protect against it, unless it be to avoid the use of amalgamating agents.

Galvanic, or bimetallic, corrosion is a localized attack which often results when two dissimilar metals are connected in an electrolyte. Under such conditions, a simple electric cell is created with current flowing from the anode, which is the metal being corroded, to the cathode, which is the metal being protected. About the only thing that can be done to eliminate or retard this form of corrosion is to place lead plates in the well in such a position that they intercept and absorb the low potential currents. The safest protection is to use similar metals throughout the entire well, including the pumping equipment.

Concentration cell corrosion is occasionally encountered in the well business, though it is rare and extremely difficult to recognize without the aid of expert chemists and physicists. It is the form of electric cell set up when one metal is placed in two different concentrations of the same electrolyte. This form of corrosion is evidenced by local corrosion occurring at random on the corroded surface. Fortunately it is not often encountered in water wells.

Most ground waters found in sands and gravels and similar formations are only mildly corrosive, if at all. Generally, a mineral analysis of the water will determine the proper metal to use in the well installation. Dissolved oxygen is probably the most important constituent in determining the likelihood of a ground water being corrosive. Hydrogen sulphide is another agent which is a sure sign of corrosiveness. The balance between dissolved carbon dioxide and the carbonates of magnesium and calcium, in combination with dissolved oxygen, determines the degree of corrosiveness of most ground waters, as well as the likelihood of incrustation. Water with a low pH (high acidity) and low carbonate hardness and high carbon dioxide content is almost certain to be corrosive. Water with a high pH and low proportion of carbon dioxide will not usually attack the metals used in wells or pumps. In connection with corrosion, it might be mentioned that the rate of corrosion is dependent on a number of factors, one of them being the rate of movement of water over the surface being corroded. To offset corrosion in wells and pumps, two general methods of approach are in common use—one is the use of protective coatings and the other is the use of highly corrosion-resistant metals. Neither method has proved to be a wholly positive safeguard against corrosion.

Incrustation of well casings, openings and screens is a deposition of materials in and around all metal parts of wells and pumps. These accumulations are largely made up of the bicarbonates and sulphates of calcium, magnesium, sodium and iron. Hydroxides and oxides of iron with other substances such as chlorides, borates, and silicates may be present, but only add to the amount and kind of deposits formed. Iron and manganese compounds are the most difficult to break down and remove as they form a harder deposit. Silt and clay may be in suspension in the water and contribute their bit to the accumulations of incrustation. Other agents contributing to incrustation are the iron-forming bacteria and slime-forming organisms, such as Crenothrix.

Correctives for Incrustation

Up to date no way has been found to prevent or entirely remove these accumulations in and around well screens and pumps. About all that can be done is to take steps to retard their accumulation. One of the things that can be done is to provide the maximum amount of transmitting capacity in the casing or screen openings, either by rebuilding the well or replacing it with a new one of better design. Another thing is to reduce the rate of pumping and increase the period of pumping. This will be effective if drawdown is materially reduced. Many well owners are finding it more economical to operate a larger number of properly spaced wells, operated at less drawdown, than to try to obtain their requirements from fewer wells having excessive drawdown.

Wherever incrustation is present, as shown by past experience, periodic cleaning of wells and pumps should be put into practice as a regular item of maintenance. Such corrective measures should be initiated at the first suspicion of incrustation, otherwise costly rehabilitation may be necessary with questionable results.

Acid treatment is by far the most common means of removing incrustation. Hydrochloric acid used with an inhibitor readily dissolves the carbonates of magnesium and calcium, also the hydroxides and oxides of iron and manganese. Chlorine in both liquid and gas form has been used with some success, especially in removing accumulations of slime-forming organisms. However, this does not prevent recurrence of the trouble.

Other chemicals such as sulphuric acid, sodium hexametaphosphate, copper sulphate, and carbon dioxide (in the form of dry ice) have been tried in many places as a means of removing incrustation. In some cases, good results have been obtained while in other cases the benefits were negligible. As yet there is no established technique for treating wells with chemicals or removing accumulations by the use of scrapers, brushes, compressed air, water or steam. Each job of this kind must be carefully studied, taking into account the chemistry involved, since the amount of incrustation depends primarily on the minerals carried by ground water, and also the rate of pumpage.

Well failures, which are due to low rate of replenishment to ground water storage, are corrected only by regulating the pumping rate to the replenishment rate. There is no other answer. Many have tried to maintain well supplies by installing larger wells and pumps, but the answer is always the same, as the safe annual yield of a well is definitely limited to the amount of annual water replenishment to the underground reservoir.

Well failures due to poor construction, or mechanical failures after construction, are in the minority. Such failures are caused mostly by the use of cheap materials, poor construction methods, improperly designed screens, poor gravel treatments, etc. There is no excuse for such failures, though they occur regularly and much too often. These failures usually occur with little or no warning. A well may suddenly collapse or start pumping large quantities of formation material. The operator can do little to foresee or prevent such failures, but

he can profit by the knowledge that such failures do occur and by taking measures to prevent them in the future.

Deep Rock Wells

The nature, construction, and hydraulic characteristics of deep rock wells are so different from shallow wells that they require special consideration and careful supervision at all times. The maintenance and operation of deep-drilled rock wells is largely a question of good judgment, coupled with experience. As far as their water supply is concerned, deep wells are dependent upon the kind of rock in which they are drilled, its ability to transmit water, the nature of the water itself and its source of origin. All deep rock wells, with the exception of wells in sandstone, get their water from rock fractures or from solution channels. The water table in rock wells slopes from the surface intake to the well, usually at a much flatter slope than the water table in an unconsolidated formation. Hence, the water moves under different hydraulic conditions and invariably is in a confined state rather than a free state. This means that the supply of a deep rock well is obtained from water rising through the larger fractures to the point of discharge. This also means that the well outlet controls the water level in the system of fractures contributing to it. The flow in this type of well may vary widely throughout a rock fracture system. It may be restricted near the well outlet and free at some distance away or vice versa. If the fracture system at the well outlet is enlarged by shooting, the use of acids or by mechanical means, the water table in the fracture system may drop rapidly and approach the level of the outlet. It is for this reason that explosives are frequently used in deep rock wells. The results are oftentimes disappointing, as the well may be filled with rock debris or new fractures opened which are filled with fine material. Shooting wells should always be done by some one thoroughly experienced in this kind of work, since it may result in damage to the well and injury to people doing the work.

Mechanically there is very little that can be done to maintain a deep rock well supply. Most operators find it necessary to go into such wells occasionally for the purpose of keeping the fractures or solution channels open. About all they can do is to scrape or brush the sides of the drill hole and thus remove any accumulations there may be. If the drill hole has become partially filled with rock debris, it is cleaned out by bailing. Acid treatment and surging is helpful in dissolving accumulations in the fractures, provided the accumulations are of such nature that acid will break them down.

Wells constructed in limestone, dolomite, gypsum, and similar formations often obtain their water from solution channels which are of different nature than rock fractures. Solution channels are created by the solvent action of water entering the vertical joints of the formation at the surface and then finding its way to the horizontal joints, which are fractures. The dissolving effect of water in such formations is well known. It is particularly effective above the water table where the movement is comparatively rapid and the water contains the maximum amount of carbon dioxide. It must be remembered, however, that it is the fractures and channels below the water table that act as a network of reservoirs supplying deep rock wells. Obviously, there may be considerable variation in the supply from the same type of formations in different localities, due to the presence or lack of caverns and major channels. In some places a well will pass through limestone without striking a water-bearing channel or fracture at all.

The chemical constituents of water obtained from deep rock wells depend to a large extent on the chemical nature of the rock itself, the rate of flow, temperature and other things. As a rule, water from deep rock wells is of higher temperature and more highly mineralized than water from shallow wells. Although such waters are better protected against pollution, it is not at all uncommon for deep rock wells to become polluted. The origin of such pollution is difficult to locate and trace. Oftentimes it is due to carelessness in and around the well or to surface contamination originating at considerable distance from the well, or to improper installation and operation of pumping equipment.

On account of the cost and nature of deep wells, they are generally pumped at greater drawdowns than shallow wells. In some cases, air lift pumping will maintain a supply when the conditions in the well are such that other types of equipment cannot be used. One of the chief causes of failure in deep rock wells is the continuous lowering of the water table or pressure level to a point where it is no longer economical to pump the well. Here again we are back to a fundamental of good well operation, namely, the regulation of pumping rates to the amount that can be safely withdrawn annually.

Protective Measures

In operating wells there are a number of things that can be done to maintain and protect a groundwater supply. The following suggestions are offered, though there are other protective measures which may be put into effect as the situation requires:

1. All wells should be located and constructed by people experienced in this sort of work and who have some knowledge of the occurrence and movement of ground water in various water-bearing formations.

2. All wells should be located so that they will not interfere with other wells operating in the vicinity.

3. All wells should be constructed in such a way that only water which is free of pollution, and is of usable quality, can get into them.

4. All wells and pumping equipment should be constructed of materials that will resist the corrosive and erosive action of the water being pumped, or of chemicals that may be used in them to remove accumulations.

5. All wells should be operated at their most economical point by equipping them with pumps properly designed for the characteristics of each installation. This means that well operators should have a means of measuring the yield, drawdown, and power consumption of every pumping unit under their care.

Finally, we come to the conclusion that good operation and maintenance of a well supply is primarily the well owner's responsibility, in providing the best well construction, pumping equipment and supervision that he can obtain. No one can deny that the operation and maintenance of a well water supply is a great responsibility. The trouble is that our municipalities, industries, and private owners take it too lightly. They are not interested until something happens, but when a water supply fails there are plenty of questions asked, with the blame usually falling upon the party least responsible.

This does not mean that the operator of a water well has no responsibility, for he has. His responsibility is to inform himself regarding the wells under his care. He must know enough about the methods and materials used in constructing wells to be able to anticipate any trouble from these sources. Furthermore, he should know enough about the local water-bearing formations and the water in them to be able to advise the owner, whether it be a municipality, industry or private institution, of any overpumping or reduction in supply. To be able to do this, the operator should

insist on having the apparatus and assistance required to make periodic readings of water levels, pumping levels, quantity of water pumped and power consumption. It is essential to make this data a matter of record because it will be invaluable in any emergency which might arise. It will also be helpful in anticipating shortages due to increased demands or failure of wells and pumping equipment. It is a well known fact in the water supply business that few people keep records. In Illinois a recent survey disclosed the fact that in 23 municipal supplies from shallow wells, only one metered the pumpage. None reported making measurements to water levels, either static or pumping. The survey also disclosed that in a group of 13 deep rock wells, none metered the pumpage or made any systematic effort to determine the performance of the wells. This record probably could be duplicated in any section of the country. This is a sad state of affairs, but it cannot be charged entirely to the operators of well supplies, as they are oftentimes burdened down with other duties varying from dog catcher to night watchman. It goes without saying that inefficient operation adds to operating costs. For this reason alone operators of well supplies should be allowed to devote their entire time and ability to bettering the operating conditions of their well installations. Most operators are capable of doing this if given the chance.

NATIONAL DISTILLERS INSTALL WASTE TREATMENT AT FRANKFORT, KY.

Waste Treatment Plant at National Distillers Distillery, Frankfort, Ky.
(Digestion, primary and secondary tanks with control building in background. Bio. filter not shown—Link Belt Equipment throughout)

Shown in the accompanying photograph is the new waste treatment plant of the Old Grand Dad Distillery at Frankfort, Ky. The photograph taken at the opening of the plant shows Vice Pres. T. F. Brown, Res. Mgr. L. B. Rodenberg and President J. E. Bierwirth of the National Distillers Products Corp.

The waste recovery and treatment process begins with an aeration system for cooling the hot wash waters used to clean distillery equipment plus a pumping system that takes the waste through a filter where solids are recovered for stock feed. The water treatment plant consists of primary settling tanks, Bio-filters, secondary settling tanks, and sludge digestion. The plant has a capacity of 200,000 gpd. and will eliminate the industrial waste pollution of Elkorn Creek.

domestic sewage treatment including sedimentation, trickling filter and chlorination.

Industrial wastes consist of oil emulsions from the process of rolling aluminum sheet and plate. This oily waste is treated and the oil separated in special tanks, from which the oil is collected and stored while the purified water is piped back to the river.

Pennsylvania Orders Clean-up on Susquehanna River

The Sanitary Water Board of Pennsylvania has issued the most extensive orders in the State's Clean Streams Program. Orders to build treatment works have gone to 55 municipalities and one institution, and orders for additions to plants will go to communities in the Susquehanna and Juniata River basins. These orders specify that all plants must be placed in operation before June 1, 1952.

With the issuance of these orders, 45 per cent of all Pennsylvania municipalities which come under the law will have been put under orders to abate pollution.

Aluminum Co. Installs Waste Treatment

At the new Davenport Works of the Aluminum Co. of America, a complete waste treatment system has been installed to protect the waters of the Mississippi River. The system includes a network of storm sewers,

ASTM Standards on Industrial Water

The American Society for Testing Materials Committee D-19 has just published a bulletin, "ASTM Standards on Industrial Water," which brings together the various ASTM standard methods of sampling, analysis, and testing of industrial water. These methods have been developed particularly for the examination of water employed industrially in the generation of steam or for process or cooling purposes, and for the examination of deposits formed from such waters.

The bulletin included 26 methods, covering sampling, analysis, corrosivity tests, and reporting. Copies of this 142-page bulletin may be obtained for $1.75 per copy from the Amer. Soc. for Testing Materials, 1916 Race St., Philadelphia 3, Penna.

"Wal—what d'ya know!"
(Courtesy, The Bell Syndicate Inc.)

MODERN WASTES TREATMENT PLANT*

For Carpet Mill of James Lees & Sons at Glasgow, Va.

by
STUART E. COBURN
Chief Chemist
METCALF & EDDY ENGRS.
BOSTON, MASS.

TRANSFORMATION of Glasgow, Va., from a pastoral town into a site of the world's most modern carpet mills has been accomplished in the almost unbelievably short space of fifteen years.

When James Lees & Sons Co. searched the Eastern seaboard in the early 30's for a new site to build a plant for their rapidly expanding carpet business, it was necessary to find a location which had the three r's—railroads, roads, and river. The Glasgow site had all three. The railroads were the Chesapeake & Ohio and the Norfolk & Western running "by the door." The roads were good. The river, the Maury or North River, ran by on its way to the confluence with the James, scarcely a mile away.

The present plant site was little more than a meadow between the river and the railroads, when Lees started training native residents in the Village postoffice in 1934. The management not only encouraged local residents to learn the complicated art of carpet weaving, but it also urged them to remain on their farms. As a result, the village of Glasgow grew but slightly. People improved their properties as they prospered with this new industrialization, but there was no influx of new residents.

That briefly sets the scene for the modern mill which covers approxi-

The Author

mately three-quarters of a million square feet.

New Plant Facilities

Completed only two years ago was the $3,500,000 spinning mill and dye house. These are air conditioned and vault-like in construction, incorporating all the most modern techniques of modern operation. Just being completed are 24 double bays which, when finished, will add approximately 109,312 sq. ft. to the floor space which includes approximately 17½ acres under one roof. Also under construction is a new boiler house for which two boilers of 275 hp. each are being installed.

Raw wool, imported from the far corners of the earth, enters the Glasgow mill at one end and a few hundred feet away, finished carpets, the latest in style and beauty, go out of the shipping room doors, in the same box cars that have unloaded the huge bales of raw wool.

Hundreds of Velvet, Wilton, and Axminster looms weave beautiful and utilitarian carpets which not only are installed in homes, large and small, all over America, but are spread on the floors of America's most modern railroad cars, leading hotels, theatres, and night clubs.

Headed by Wert Faulkner, the first Lees employee to be signed up at Glasgow, approximately 2,000 employees, nearly all native to the area, have not only learned how to weave carpet but have become most adept in this ancient yet rapidly changing craft.

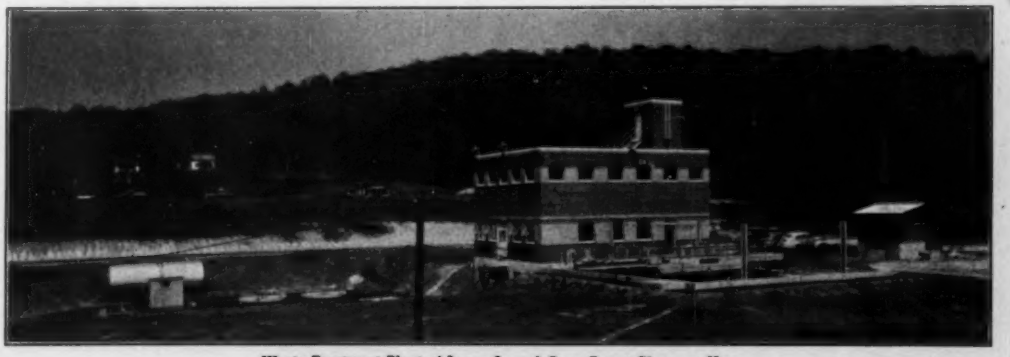
Lees, a company now in its 103rd year, is proud of this new plant which complements its parent carpet and knitting yarn plant at Bridgeport, Penna., as well as the processing plant at Carlisle, Penna.

Industrial Wastes Treatment

In the manufacture of carpets at the Blueridge Division of the James Lees & Sons Co., the usual unit operations of wool scouring, dyeing, spinning, weaving, and finishing are employed. Industrial wastes which must be disposed of are produced by some of these operations.

The passage of a water control act by the Virginia Legislature in 1946 made it necessary for the company to provide treatment for the mill sewage and treatment of the liquid industrial wastes produced by exten-

*Photographs by courtesy of *Textile World*.



Waste Treatment Plant of James Lees & Sons Co. at Glasgow, Va.

sions of the mill carried out in 1946. Prior to the additions to the plant, only weaving operations were carried out, and there was no liquid industrial wastes problem.

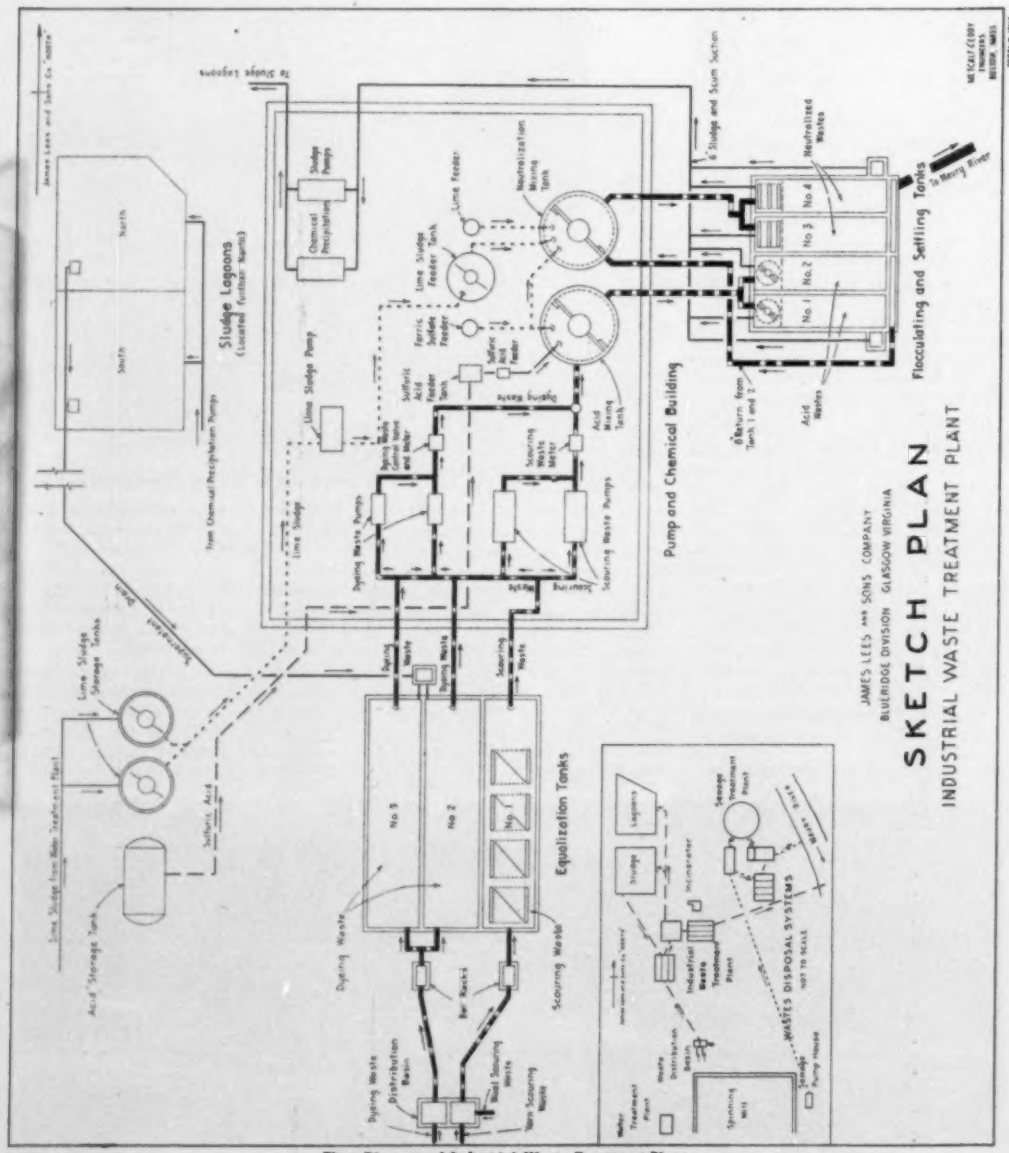
Two distinctly different types of wastes are discharged from the mill; first, the strongly alkaline scouring liquors containing considerable quantities of dirt, burrs, grease, suint, excreta, and other substances removed in washing the raw wool; and second, the highly colored spent dye liquors discharged from stock and yarn dyeing.

Preliminary investigations were made by Metcalf & Eddy and the Lees technical staff at another plant of the same company on wastes from similar scouring and dyeing operations to determine the characteristics of the wastes to be treated.

From these investigations, the method of treatment was determined and basic data for design of a full-scale treatment plant were obtained.

Wastes Treatment Plant

The two types of industrial wastes are collected in a two-compartment distributing basin and flow thence through separate pipes by gravity to bar racks for removal of fiber, and then into three equalization tanks where peak discharges and strengths are leveled out to allow the treatment



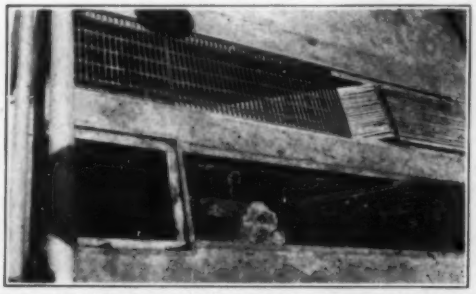
Flow Diagram of Industrial Waste Treatment Plant

plant to be operated at a relatively uniform rate.

One equalization tank receives the scouring wastes. This tank is equipped with motor-driven paddles to keep the grit and other settleable solids in constant agitation to prevent sedimentation. The other two tanks receive the acid dye liquors. These tanks are not equipped with paddles, but are lined with a thermoplastic resinous membrane to prevent disintegration of the concrete. The wastes are pumped through separate pipe systems from the hoppers at the end of the equalizing tanks to an acid mixing tank where the two separate wastes come together for the first time. Here sulfuric acid is added to adjust the pH to a predetermined figure and to coagulate the grease and other colloidal matters.

The acidified wastes flow to the flocculating and sedimentation tanks and are settled to remove the flocculated material. The settled liquors then pass over a baffled weir to a second set of mixing tanks where hydated lime is added to neutralize the acidity before discharge to the Maury River.

Lime sludge discharged from the water treatment plant is also used for neutralization of the acidity, thus reducing the quantity of hydrated lime to be purchased. The addition of lime causes secondary precipitation of solids which are removed in a second battery of tanks.



Bar Rack of Wrought Iron for Scouring Waste Channel and of Wood for Dye Waste Channel (Grating removed)

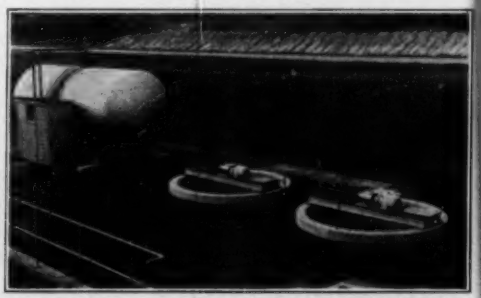
(Wastes flow by gravity on way to equalization tanks. Screenings removed by hand, drained and burned in an incinerator.)

Equalization Tanks of Which There Are Three

(Dye wastes are shown entering the middle tank. Tank at right is also for dye wastes. Both have flat bottoms and sumps at effluent end. Left tank is for scouring-waste with four paddles to prevent sedimentation.)

Adjustable Scum Removal Pipe at End of Acid Flocculating Tank

(Scum is pushed slowly into the pipe by collector blade, which is mounted on a reciprocating carriage and moves back and forth in the tank at 3 ft. per min.)



Storage Tanks—Sulfuric Acid (left); Waste Lime Sludge (right).

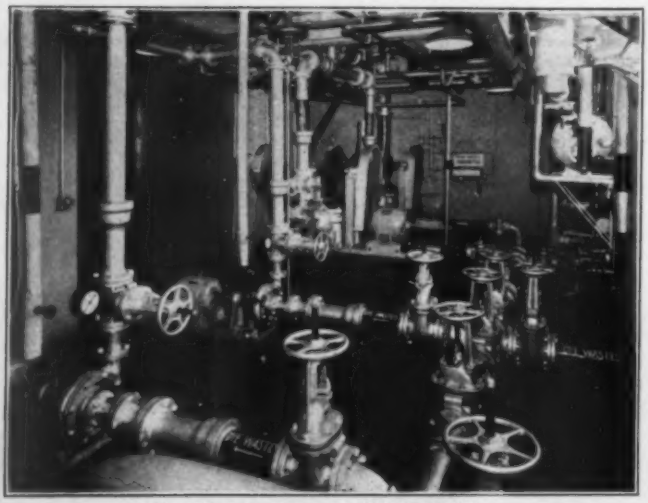
(Lime sludge is obtained from water softening plant. Acid is added to combined waste to aid in precipitation of solids. Lime sludge neutralizes settled acidified liquor.)

Lagoons for Sludge from Settling Tanks

(Supernatant liquor from sludge is drawn off at chamber in foreground and returned to dye equalization tanks. Sludge enters at opposite side of lagoon. Earth dikes are 10 ft. high.)

Control Laboratory in Chemical Building

(Periodic tests are made to insure proper dosage of chemicals. Changes in characteristics of waste require occasional adjustment of acid and lime additions. Records are kept of operation results.)



Pump Room in Basement of Chemical Building

(Dye waste pumps are of stainless steel. All pumps installed in duplicate. Note labels on various lines. Kennison nozzle and orifice meters are used to measure flow of wastes.)

Under certain circumstances, an additional coagulating agent is necessary to produce a satisfactory effluent. At these times, ferric sulfate can be added to either the acidified wastes or to the lime-neutralized wastes.

The sludge produced by chemical treatment is pumped intermittently to sludge lagoons. The supernatant liquor from the consolidating sludge is returned to the wastes in the dye wastes equalizing tank.

A laboratory, equipped for making routine operating tests only, is installed in the pump-and-chemical building. The usual auxiliary systems, such as those handling and feeding sulfuric acid, lime sludge, and dry chemicals, and utility systems for water supply for domestic use and fire protection, steam for building heating and domestic water heating, electricity for power and lights, compressed air for handling acid displacement for instrument lines and for the removal of sewage to the sewage treatment plant, have been installed.

Dry chemicals are stored in the upper story of the pump-and-chemical building. This storage room is isolated from other spaces by having its access stairway entered from the outside of the building; thus, chemical dust is excluded from other parts of the building.

Operation Data

The plant was designed to treat a total of 250,000 gal. of wastes per day. At present, the daily flow amounts to approximately 180,000 gal.

Three operators working in eight-hour shifts operate the plant with the assistance of a helper on the day shift. Maintenance and necessary repairs are taken care of by the proper departments of the mill.

The plant is operated principally by pH control, the operator on each shift making routine laboratory tests to be sure that the proper dosage of chemicals is being applied.

Changes in characteristics of the scouring-liquor or dye-house wastes require infrequent changes in the settings of the acid and lime machines. Periodic laboratory tests are made in the laboratory to determine optimum quantities of chemicals required for treatment.

Results of analyses of the wastes and effluents made by the State Water Control Board on samples collected by its representatives are given in the accompanying tables. Table 1 shows the results obtained by the temporary plant while the wastes treatment plant was being constructed, and Table 2 gives the results accomplished by the permanent plant.

Sewage Treatment Plant

In order to comply with the orders of the State Water Control Board, in regard to sewage treatment, a standard Imhoff-trickling filter plant was designed and constructed.

The sewage is received from the mill at a common point and pumped to the Imhoff tank, settled, and then applied to a standard trickling filter by means of a rotating distributor. The filtered sewage is then settled and discharged to the Maury River. During the summer period, or period of low stream flow, the effluent can be chlorinated before discharge.

The sludge from the secondary tanks is pumped back to the Imhoff tank for digestion. Periodically, the sludge from the Imhoff tank is removed to sludge beds for drying and subsequent removal.

Table 1

RESULTS OF ANALYSES OF COMBINED WASTES AND LAGOON EFFLUENT* (TEMPORARY PLANT)

Results in ppm.

Constituent	Mixed wastes (1)	Acid lagoon effluent (2)	Lime lagoon effluent to Maury River (3)	Lime lagoon effluent to Maury River (4)
	Collected August 28-29, 1947			
B.O.D.—5 day	3,652	1,784	1,316	930
Set. Sol., ml./L	1.5	0.1	0.6	.....
Residue				
Total	11,331	6,877	6,235	.....
Volatile	6,850	2,590	2,014	.....
Ash	4,481	4,287	4,221	.....
Alk. as $CaCO_3$	1,428	.....	583	437
Acid. as $CaCO_3$	.....	35	.....	.....
pH	8.8±	4.2±	7.1±	6.8±
Grease	2,300	453	237	206
Appearance	lt.-brn.	grn.-tan	dk.-grn.	

(1) Samples collected every 15-min. interval, composited every 2 hr. over a period of 24 hr.
(2) Samples collected 3 p.m., 3 a.m., and 3 p.m.
(3) Samples collected once an hour, composited every 2 hr. over a period of 24 hr.
(4) Average of 13 samples collected between October 28, 1947, and July 3, 1948.

*Analyses by Va. Water Control Board.

Table 2

RESULTS OF ANALYSES OF COMBINED WASTES AND FINAL PLANT EFFLUENT*

Results in ppm.

Constituent	Mixed wastes	Final effluent	Removed, %
	Collected February 1-2, 1949		
B.O.D.—5 day	2,260	915	60
Residue			
Total	9,455	7,617	19
Volatile	3,755	1,743	54
Ash	5,690	5,874	—3
Susp. Sol.			
Total	3,793	156	96
Volatile	2,640	40	99
Ash	1,153	116	90
Alk. as $CaCO_3$	933	734	21
pH	7.3±	7.8±	...
Grease	1,600	51	97

*Analyses by Va. Water Control Board.

Acknowledgement

The owners, James Lees & Sons Co. were represented by Fred Smith, Vice-President; in business matters by H. F. Keeler, Purchasing Agent; in engineering matters by R. E. Oberholtzer, Chief Plant Engineer; and in preliminary chemical investigations and in plant operation by William Ebersold, Chief Chemist. Wert Faulkner, Plant Manager for the Blueridge Division, was the local

representative of the company on construction.

The sewage treatment plant and the sludge lagoon earthwork for the industrial wastes plant was done by the Daniel Construction Co., of Greenville, So. Car.; and the temporary treatment works and the permanent industrial wastes treatment plant were built by B. F. Parrott & Co., Inc., Roanoke, Virginia.

The sewage treatment plant was designed by The Ballinger Co., of Philadelphia, Penna., and the temporary and permanent wastes treatment plants were designed by Metcalf & Eddy, Boston, Mass.

BASIC DESIGN DATA

Volume of Waste	
Wool and yarn scouring	73,000 gpd.
Dyeing	177,000
Total	250,000
Bar Racks	
Channel dimensions	1.5 x 3.0 ft. deep
Bar spacing—clear	¼-in.
Rack slope to horizontal	30°
Equalization Tank—3	40,000 gal. each
Det. period—Scouring waste	6½ hr.
Dyeing waste	5½ hr.
Acid and Neutralizing Mixing Tanks	
Volume	2,600 gal.
Detention period	15 min.
Flocculating and Settling Tanks	
Volume	24,000 gal.
Det. period—Flocculating	30 min.
Settling	4 hr.
Sludge Lagoons	
Water depth	8 ft.
Volume	270,000 cu. ft.
Dikes—top width	4 ft.
Slope-horiz. to vertical	2:1
Pumps	
Scouring waste—2 duplex plunger	150 gpm.
Dye. waste—2 centrifugal	150 gpm.
Chem. sludge—2 simplex plunger	60 gpm.
Lime sludge—1 simplex plunger	50 gpm
Dry Chemical Feeders	
Lime	2,500 lb./day
Ferric sulfate	1,000 lb./day
Chemical Storage Tanks	
Lime Sludge	3,500 gal.
Sulfuric Acid	10,000 gal.

Wisconsin Research Develops Phosphorus Removal Plant

Profs. Lea and Rohlich Make Announcement

Prof. William L. Lea and Prof. Gerard A. Rohlich of the Univ. of Wisconsin department of civil engineering have announced the development of a pilot plant for the removal of phosphorus from sewage plant effluents.

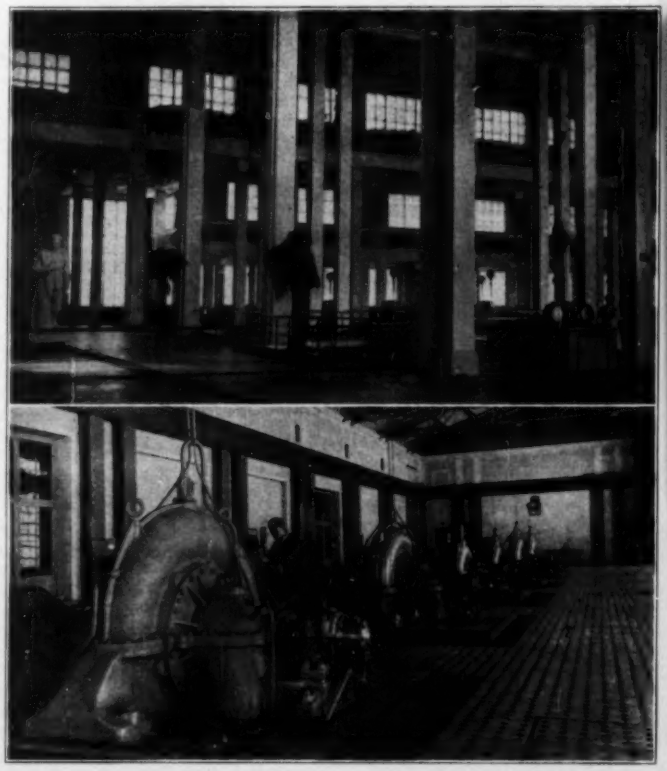
This work which was prompted by studies of algae in lakes and the fertilizing effects of surplus phosphorus on the growth of algae. The report was made to the University's Lake Investigations Committee.

Working at the Nine Springs Treatment plant of the Madison Metropolitan Sewerage District, Lea and Rohlich have been able to reduce the phosphorus content of the sewage plant effluent from 7.0 to 0.7 ppm.

The investigators estimate that approximately one ton of saleable phosphorus could be recovered each day from the 15 mgd. sewage flow. About 60 per cent of the organic nitrogen and 84 per cent of the B.O.D. is also removed but nitrogen in other forms is not affected.

The Lea-Rohlich process is one of flocculation involving the addition to about 200 ppm. of alum and mixing for 15 min. after which the alum and phosphorus settle to form a sludge. Recovery of the alum and phosphorus is brought about by treatment of the sludge with sodium hydroxide to bring both into solution. Calcium chloride is added and calcium phosphate settles out. The sodium aluminate is reused and recovers about 93 per cent of the alum.

BEHIND THE "IRON-CURTAIN"



These pictures have come to us from deep behind the "Iron Curtain." They are of the Stalin Filtration Plant and Pumping Station serving Moscow. Sorry that no information concerning the manufacture of filter equipment or pumps accompanied the pictures; but, aside from the massive plaster of Paris statue of "Joe" himself facing the entrance, we were interested in the papier-maché "Moscow Palms" flourishing in nail-kegs; also, in the fact that they employ women filter operators.

DETERMINATION OF METALS IN INDUSTRIAL WASTES

Part II—Chromium, Vanadium and Cyanide

H. GLADYS SWOPE[1], BETTY HATTMAN[2] AND CATHERINE PELLKOFER[2]
ALLEGHENY COUNTY SANITARY AUTHORITY, PITTSBURGH, PA.

IN PART I of this article, the determination of iron and copper were discussed. This concluding section deals with chromium, vanadium and cyanide determinations.

CHROMIUM

Several methods were tried for chromium and the method finally chosen was a modification of that found in Griffin's "Technical Methods of Analysis."[(1)] This method was tried on sewage samples to which known amounts of chromium had been added between the ranges of 0.10 to 5 mg. of chromium, before using the method on unknown industrial waste samples.

Procedure

1. One liter of the waste should be concentrated to 250 ml. unless the sample is known to contain at least 0.05 mg. of chromium.
2. Five ml. of 1:3 nitric acid were added to the concentrated sample in a 500 ml. Erlenmeyer flask and the oxides of nitrogen were boiled off.
3. A 2N solution of potassium permanganate was added drop by drop to the boiling solution until a fairly strong violet color was obtained. Boiling was continued not only until all the permanganate was converted to manganese dioxide but also for an additional 20 minutes.
4. The flask was then cooled under running water and the solution filtered through Whatman No. 2 filter paper.
5. To the filtrate an excess[(a)] of ferrous sulfate[(b)] or ferrous ammonium sulfate[(b)] was added from a burette. There was not an excess of the ferrous salt if the solution remained yellow. Only 10-25 ml. of the ferrous salt was necessary for an excess if the amount of chromium did not exceed 3 ppm.
6. The solution was allowed to stand five minutes and was then titrated with 0.006N[(c)] ceric sulfate using

The Senior Author

o-phenanthroline as an indicator. The ferrous solution equivalent to the standard ceric sulfate must be determined daily.

(a) An excess was determined by the spot plate method using potassium ferricyanide as an outside indicator. The potassium ferricyanide is unstable so that the indicator was made up daily by dissolving a crystal in approximately 50 ml. of distilled water.
(b) The ferrous solution was made up in a 500 ml. volumetric flask using 0.81 gm. of $FeSO_4.7H_2O$. (This gave a normality of around 0.006N). Before diluting to volume, 5 ml. of concentrated H_2SO_4 was added to the solution. A corresponding larger weight of $Fe(NH_4)_2(SO_4)_2.6H_2O$ was used and the solution made up in the same manner.
(c) 0.006N ceric sulfate was used in this work. A weaker or stronger solution may be used if desired.

Calculations:

$$\text{ml. ferrous soln. (in terms of } Ce(SO_4)_2 \text{ equivalent)} - \text{ml. } Ce(SO_4)_2 \text{ titrated} = \text{ml. ferrous soln. used.}$$

$$1 \text{ ml. } 0.01 \text{ N } Ce(SO_4)_2 = 0.1734 \text{ mg. Cr.}$$

$$\frac{\text{ml. ferrous soln. used} \times \text{N } Ce(SO_4)_2 \times 17.34 \times 1000}{\text{ml. sample}} = \text{ppm. Cr.}$$

It may be helpful to enumerate the methods which were tried for chromium which were not found satisfactory for industrial waste samples, or for those containing sewage. The first method[(1)] consisted essentially of acidifying an aliquot of the sample, adding an excess of standard ferrous sulfate and titrating with standard potassium permanganate. This method was unsatisfactory since more potassium permanganate was used than the ferrous sulfate. The method was used by Herda[(2)] on concentrated chromic wastes and he found it satisfactory.

The next method was an adaptation of that given in Scott's "Standard Methods of Chemical Analysis."[(3)] A portion of the sample was made alkaline with 50 per cent sodium hydroxide and any precipitate was filtered off. The filtrate was treated with bromine water to oxidize the chromium. Twenty ml. of 30 per cent potassium acid sulfate were added and the solution boiled to expel the bromine. The solution was then made acid with sulfuric acid and an excess of 5 ml. of 1:1 sulfuric acid per 100 ml. of solution added. Standard ferrous sulfate was added and after allowing the solution to stand for five minutes the excess was titrated with 0.01N potassium permanganate. The addition of 3-4 ml. of syrupy phosphoric acid gave a sharp end-point. On the five industrial waste samples tried, the titrations were all in excess of the ferrous sulfate added. This showed that there was something present which was reducing the potassium permanganate in addition to the ferrous sulfate; organic matter was one possibility. In order to destroy the organic matter a portion of the sample was acidified with sulfuric acid and fumed. Hydrogen peroxide was used to oxidize the chromium instead of bromine. The results with this procedure were low.

Another method consisted of digesting the sample with sulfuric acid, diluting, making basic with sodium hydroxide, boiling with sodium peroxide, acidifying with sulfuric acid until weakly basic, adding potassium acid sulfate and standard ferrous sulfate, and titrating the excess ferrous sulfate with ceric sulfate. Again the results were low. Thinking that the difficulty this time might be due to an excess of peroxide in the solution after acidification, the procedure was repeated with two standards, following the method given, except that these known samples were not fumed; the sample was made weakly basic (pH between 8-9) and making certain that all the peroxide was expelled by boiling for a few minutes. The results were slightly low. It was

[1] Present address: Argonne National Laboratory, Chicago, Illinois.
[2] Present address: City of Pittsburgh, Bureau of Tests, Pittsburgh, Pa.

also found that a blank had to be considered. Fuming with sulfuric acid also caused low results, as a comparison of known samples with and without fuming were made.

Oxidation of organic material was tried using a strong solution of potassium permanganate. The sample was made alkaline and then several drops of 2N potassium permanganate were added and the solution boiled. The excess permanganate was removed by the addition of two drops of ethyl alcohol. The solution was then filtered and washed. The filtrate was treated with sodium peroxide and boiled for thirty minutes and the procedure continued as in the previous method. The results were much too low.

VANADIUM

Vanadium and chromium were obtained on the same sample. The method used was an adaptation of the one described by Willard and Young[7] for the direct determination of vanadium and chromium in steels. Willard and Young used perchloric acid as the oxidizing agent whereas a strong solution of potassium permanganate (2N) was found to be satisfactory and the final titration was carried out using ceric sulfate instead of potassium permanganate.

Procedure

1. To a suitable aliquot, containing from 2-10 mg.* of vanadium was added 3 ml. of concentrated sulfuric acid and 2 ml. of 1:3 nitric acid and the solution boiled.
2. 2N potassium permanganate was added dropwise to the boiling sample (about 4-5 drops) until a strong violet color was obtained.
3. Boiling was continued not only until all the permanganate was converted to manganese dioxide (black precipitate) but also for an additional twenty minutes.
4. The manganese dioxide was filtered off, through qualitative filter paper, and 10 ml. of sulfuric acid (sp. gr. 1.5) was added to the filtrate.
5. The sample was then chilled to 5°C or lower and an excess[a] of standard ferrous sulfate[b] or ferrous ammonium sulfate[c] was added.

(a) An excess was determined by the spot plate method using potassium ferricyanide as an outside indicator. The potassium ferricyanide is unstable so that the indicator should be made up daily by dissolving a small crystal (about the size of a pencil point) in 50 ml. sulfuric acid.
(b) Ferrous sulfate should be made up about twice the strength of ceric sulfate.
(c) Used 5 grams per liter.

6. The titration was carried out with standard ceric sulfate using o-phenanthroline as an indicator. The ferrous sulfate solution should be about twice the strength of the ceric sulfate.
7. After the first titration 10 ml. of concentrated ammonium hydroxide was added slowly, while stirring.
8. Add 20 grams of sodium acetate and heat the solution to 50°C, stirring constantly.
9. The solution is titrated with standard ceric sulfate.

*Some indication of the amount of vanadium present may be obtained from the appearance of the sample. In this case all the samples were highly colored (some yellow, some green) and it was believed that the vanadium content was fairly high. One ml. of 0.006N ceric sulfate will oxidize 0.3 mg. of vanadium and 50 ml. will oxidize 15 mg.

Calculations:

$$\frac{(\text{ml. ceric sulfate equivalent to ferrous sulfate added}) - (\text{1st and 2nd titrations}) \times 17.34 \times N\ Ce(SO_4)_2}{} = \text{mg. chromium}$$

$$\text{ml. 2nd titration} \times 51 \times N \text{ ceric sulfate} = \text{mg. vanadium}$$

1 ml. 0.006N $Ce(SO_4)_2$ = 0.104 mg. Cr.
1 ml. 0.006N $Ce(SO_4)_2$ = 0.306 mg. V

CYANIDE

More difficulty was experienced with the cyanide determination than almost any other. No trace of cyanide could be detected chemically in industrial waste samples which, at least by odor, appeared to contain this radical. Even synthetic solutions containing known amounts of sodium or potassium cyanide did not seem to yield to quantitative measurement.

There has been so much discussion and difficulties experienced with this determination that the methods tried will be reported in detail.

The first method tried was that used by Herda[8] of the Willow Run, Mich., plant of the Kaiser-Frazer Corporation. One hundred ml. samples were filtered, 2 ml. of 10 per cent potassium iodide and 5 ml. of ammonium hydroxide were added and the solution mixed. Filtration was again carried out if necessary and the pH adjusted to just acid with phenolphthalein. The samples were titrated with 0.0141N silver nitrate until the first faint yellow color was obtained. The end-point was quite troublesome and led to the abandonment of the method. After experience was obtained with this end-point using another method, time did not allow a repetition of this work.

A method which might turn out to be very practical was that of distilling the cyanide-containing samples from strong acid solution. Pagel and Carlson[9] obtained very good results with this method after devising a very ingenious method of collecting the distillate.

The next method was that given in "Standard Methods."[6] Solutions containing known amounts of cyanide were made acid with tartaric acid and distilled into 200 ml. volumetric flasks. The distillates were evaporated on a water bath with 0.2 ml. of 0.25N sodium hydroxide and 0.5 ml. of yellow ammonium sulfide. As the yellow color faded, yellow ammonium sulfide was added. The residues were taken up with 10 ml. of distilled water, 1.0 ml. of 1:8 hydrochloric acid added and the solution heated just to boiling. The mixtures were allowed to stand for a few minutes and filtered. Standards were placed in 50 ml. Nessler tubes and 1.0 ml. of 10 per cent ferric chloride added and the colors compared. The samples showed a color corresponding to only about 0.05 mg. cyanide regardless of the amount of cyanide actually present in the known samples. It was thought that the loss of the cyanide occurred during distillation so the precaution was taken of putting the delivery tube under the surface of the solution (50 ml. of distilled water containing 0.2 ml. of 0.25N sodium hydroxide). The entire distillate was evaporated with yellow ammonium sulfide, but no more sodium hydroxide was added. There was still no appreciable change in the amount of cyanide recovered.

Three sets of samples containing 1.0 ml. and 2.0 ml. of the potassium thiocyanate standard solution plus 10 ml. water were taken and 1 ml. of 1:8 hydrochloric acid added. One set was brought just to boiling; one set was boiled for five minutes and the last set was allowed to stand on a hot water bath for one hour. In the first case the amount of potassium thiocyanate added was recovered completely. The same procedure was repeated using known amounts of potassium cyanide but all the results were much too low. It was concluded that the cyanide was not being converted to thiocyanate.

The modified Liebig[6] titration method was next tried. Although this method is well outlined in an article by Griffin[10] it was not found satisfactory — perhaps more experience with it was required. One and two liter alkaline samples of the cyanide-containing wastes were evaporated to approximately 500 ml., filtered into an 800 ml. Kjeldahl flask, made nearly acid with sulfuric acid, 100

ml. of glacial acetic acid added and the mixture distilled into an Erlenmeyer flask containing 50 ml. of distilled water and 5 ml. of 10 per cent sodium hydroxide solution. One hundred ml. were distilled, the distillate filtered, a few crystals of potassium iodide added and the solution titrated with 0.0141N silver nitrate. During the distillation, however, the distillate was found to be acid each time it was tested, although Griffin's method stated that the 5 ml. of 10 per cent sodium hydroxide should be sufficient to keep the pH above 12. Each time the distillate was tested and found to be acid more alkali was added but it still seemed impossible to keep the distillate on the alkaline side. The acid condition, of course, would cause loss of cyanide. Due to the pressure of the work this procedure was abandoned in favor of the one by Heiman and McNabb[9] and is outlined below:

Procedure

Collection of Sample: If the sample as collected is not already alkaline, i.e., pH greater than 9.0, the sample on collection must be put into a bottle containing 20 ml. of 50 per cent NaOH for each gallon of waste.

1. Take a suitable portion of the sample containing from (0.7 to 15 mg.) cyanide.* If the sample volume is above 250 ml. concentrate the alkaline solution on the hot plate to around 250 ml., filter through a Whatman No. 1 filter paper into a 500-800 ml. Kjeldahl flask. If the sample volume is below 250 ml., filter make up to 250 ml. and place in a Kjeldahl flask.
   Note: For less than 5 ppm. CN^- use 1000 ml. sample. For 5-25 ppm. CN^- use 500 ml. sample. For 25-50 ppm. CN^- use 250 ml. sample.
2. Use a 300 ml. tall form Berzelius beaker as the receiver. To this add 70 ml. of a 1.5 per cent sodium hydroxide solution. Have the delivery tube extend under the surface and almost to the bottom of the beaker.
3. Add a small piece of litmus paper to the solution in the Kjeldahl flask. Dilute 10 ml. conc. hydrochloric acid to 100 ml., add to the Kjeldahl and immediately connect with the condenser. If the solution is not acid more hydrochloric acid must be added. However, 10 ml. is usually sufficient. Distill for approximately 45 minutes.
4. Add 6 ml. of 6N ammonium hydroxide containing 3.3 per cent of potassium iodide to the distillate and titrate with .0141N silver nitrate. The end point is obtained at the appearance of a bluish opalescence. A piece of glazed black paper may be used as a background. The end point is definite but the titration must be done slowly so that it is not passed.

*Some idea of the concentration of CN^- may be obtained by running a rough preliminary titration on a filtered portion of the original sample. Using a 250 ml. sample a titration of 1 ml. will give 2.9 ppm. and with 50 ml., 146 ppm.

Calculations

$$\frac{\text{1 ml. .0141N } AgNO_3 = 0.733 \text{ mg. } CN^-}{\text{ml. } AgNO_3 \times 0.733 \times 1000} = \text{ppm. } CN^-$$
$$\text{ml. sample}$$

Practice with this end-point is necessary to obtain check results but once experience is gained with it, it does not seem to give any particular trouble. Note: 0.01N silver nitrate is satisfactory—the 0.0141N was that used for chloride determinations and was already available and standardized.

The analytical methods reported in this paper have only scratched the surface in attempting to find the best method for any one determination. The work was done under high pressure inasmuch as analyses were required and at the same time suitable methods for these analyses had to be worked out. Full-time research on some of these methods is the only approach to develop fool-proof methods. A complete survey of the literature should be made and various methods tried with industrial waste samples.

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C. C. Agar Dies Suddenly

C. C. (Charlie) Agar, Chief of the Water Pollution Control Section of

the New York State Health Dept., died suddenly on Feb. 15. Mr. Agar had been appointed to his position only last summer following the creation of the Water Pollution Control Board in N.Y. State and he was actively engaged in implementing the work of the new section with mobile laboratory and field staff.

A graduate of Worcester Polytechnic Institute in 1920, Mr. Agar was first chemist and bacteriologist of the City of Worcester, Mass., and later research chemist at that city's sewage treatment plant. In 1929 he joined the Division of Sanitary Engineering in the N.Y. State Health Dept. During the war, Agar rose to the rank of Lt. Col. and was on General Patton's Headquarters Staff throughout the European Campaign. Col. Agar had remained active in the Reserve Corp. and had recently passed examinations for the rank of Colonel.

In addition to his professional work and his active interest in the reserve military organizations, Col. Agar maintained his interest in the New York State Sewage Works Assn. of which he was president in 1937 and from which he received the Kenneth Allen Award the same year. At the time of his death he was Chairman of a Training Manual Committee for that organization and had succeeded in bringing it to an expected completion in 1950.

Briley, Wild & Associates New Consulting Firm

Harold D. Briley and Harry E. Wild have announced the organization of Briley, Wild & Associates, Inc. as Consulting Engineers with offices at 550 North Oleander Ave., Daytona Beach, Fla.

The new firm will specialize in water supply and treatment, sewage treatment, industrial waste treatment, garbage disposal, roads and streets, drainage, bridges, and related work.

PILOT PLANT TESTS ON HIGH RATE BIOLOGICAL OXIDATION OF SEWAGE

by

A. A. KALINSKE,
Director of Development,
INFILCO, INC.

The Author

THE oxidation of the organic matter in sewage and wastes occurs quite rapidly when proper aerobic conditions are maintained for biological life, such as is done in the activated sludge type of treatment. Since the adoption of the activated sludge type of treatment there have been numerous basic research studies which have partially explained the intrinsic nature of this process of biological oxidation and have indicated what factors influence the rate at which this oxidation proceeds. The rate of oxygen utilization by activated sludge, and by activated sludge mixed with the sewage, and the factors on which such rate of utilization depends has been studied in the laboratory quite extensively, and some of the first studies of such type were made by Grant, Hurwitz and Mohlman (1).

The Activated Sludge Process

Quantitative methods for measuring the rate of oxygen utilization, and therefore the rate at which activated sludge oxidizes organic matter, have been discussed in papers by Kessler and Nichols (2) and Sawyer and Nichols (3). A study of this basic research work indicates that activated sludge has the ability to utilize oxygen at much higher rates if the physical conditions are maintained at optimum. The studies by above-mentioned investigators and the work done by Rohlich (4), using oxidation-reduction potential measurements, have indicated that the oxidizing intensity of the activated sludge and sewage mixture varies from the time the sludge is initially mixed with the raw sewage until hours later when the oxidation is almost completed.

The treatment process that is implied when the phrase "activated sludge treatment" is used, in general means a cyclic operation consisting of the following steps: Mixing of the raw sewage with settled sludge returned from the final clarifier, agitation and aeration of this mixture either mechanically or by diffused air, and settling of the aerated mixture in a final clarifier from which the settled sludge is returned for mixing with the incoming raw sewage. It has been recognized for sometime that there is considerable benefit if the incoming raw sewage is not simply fed into one end of an aeration basin, or basin system, but rather that there is an attempt made to more uniformly and more quickly disperse the incoming raw sewage into the entire volume of activated sludge in the aeration basins.

In other words, there is every reason to believe that the efficiency of the oxidation process could be considerably increased, if all of the activated sludge organisms available in the aeration basin system could be made to work at a rate of oxidation which more nearly equals the rate obtained when the organisms come in initial contact with the incoming raw sewage. There is no particular reason why the organisms must go through a cycle of being fed a very large quantity of food and oxygen at one stage of the treatment process, and then gradually allowed to become starved and depleted of oxygen towards the end of the cycle. The writer can see no benefit to such a cyclic process.

Fig. 1—View of Pilot Plant

It would appear that a more ideal method of utilizing the oxidizing ability of the organisms would be to continually feed and disperse the raw sewage or wastes quickly throughout the entire body of activated sludge that is available. At the same time oxygen should be continually supplied to this entire body at the necessary rate, and the treated liquid separated from the mixture in such a manner so that there is no stage at which the organisms are depleted of food or oxygen, such as occurs in the final clarifier of the conventional activated sludge plant. Any apparatus or equipment designed to make such maximum use of the oxidizing ability of activated sludge would have to have as one of its prime features very intense mixing and dispersion of the incoming raw sewage and air in order to make sure that food and oxygen are brought to the surface of the organisms rapidly and continually.

Design of Aero-Accelator

In designing an apparatus for achieving the above-described method of operation when utilizing the activated sludge method of treatment, ideas were borrowed from equipment that is designed for obtaining accelerated chemical treatment of water. For instance, in the process of softening water it is extremely important, if the chemical reactions are to be rapid and approach completion, that the raw water, chemicals, and previously-formed precipitates be intimately mixed rapidly and completely in very short time. The Accelator which is used for such water treatment does just that, and in addition is so designed that a quiescent zone is maintained from which the treated and clarified water is being continually separated from the surface of a moving pool of slurry. The sketch shown in Fig. 2, which schematically shows the design of the pilot plant used in

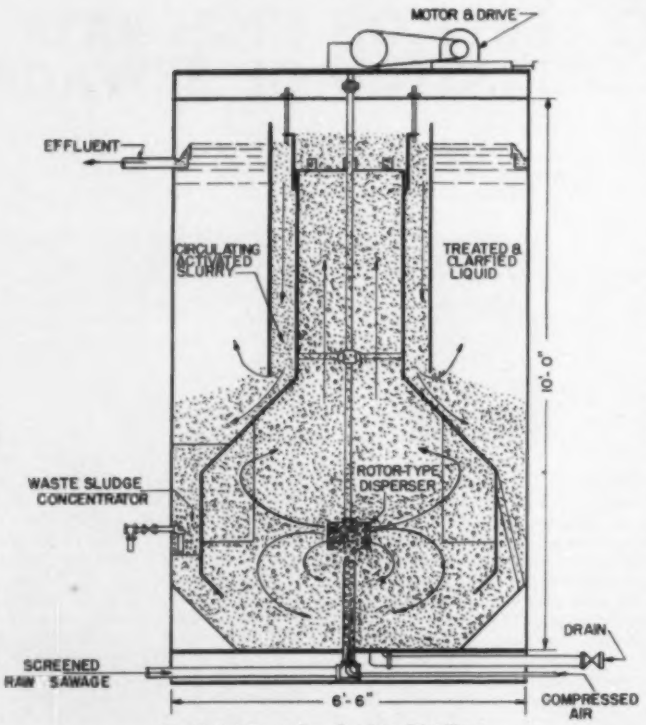

Fig. 2—Interior of Aero-Accelator Pilot Plant

these experiments, utilizes the Accelator principle of rapid and intense mixing of incoming liquid with the previously-formed solids in the primary mixing chamber, and the circulation of this mixture in such a manner that the treated liquid is separated from the solids without allowing any of the solids to settle. This latter point is of extreme importance.

It will be noted that a mechanical type of mixer is used which simultaneously disperses the incoming raw sewage and compressed air throughout the body of slurry under the conical-shaped structure in the bottom of the basin. The shearing action of the revolving multiple-bladed rotor is such that large bubbles of incoming air are broken up and dispersed into very fine bubbles throughout the entire mass of liquid in the primary mixing chamber. The bubbles then rise vertically up the center tube and escape at the surface. The presence of the air-liquid mixture in the center tube, in the special structural design used, produces a circulation of the mixture due to the air-lift action. The circulation is in the direction of the arrows and is at a rate that is several times that of the throughput of sewage being treated.

In other words, solids from which the treated liquid has separated are coming down in the form of a suspension back into the main mixing chamber rapidly enough so that there is very little oxygen depletion in this slurry. In one part of the tank, for about a 30° sector, there is no return of the slurry since there is installed a closed-bottom hopper which is known as the concentrator. The slurry entering this concentrator settles and thickens for final disposal and is never again used in the process. The slurry concentration is controlled by adjustment of the wastage from the concentrator.

The term "activated slurry" is used advisedly in connection with this treating apparatus since the phrase "activated sludge" has been associated with the method of treatment where solids in the mixed liquor are allowed to settle and then are returned from mixing with the incoming raw sewage. The term "sludge" usually means settled solids, and since the solids in this equipment are continually being used in the treatment process, it is believed that the term "slurry" is more appropriate. Only the solids that enter the concentrator for final disposal are referred to as sludge.

Pilot Plant Tests

The pilot plant shown in Fig. 1, which has a liquid capacity of 2300 gallons, was set up at the sewage disposal plant of Elmhurst, Ill., where ordinary domestic sewage could be readily obtained and facilities were favorable for carrying on the pilot plant investigation. The work was carried on during the early months of 1949 and the sewage available approximated that of ordinary domestic sewage, somewhat on the weak side. During periods of rain or heavy thaws considerable infiltration and storm water cut down the strength of the sewage appreciably.

The pilot Aero-Accelator was supplied with sewage which was taken after comminution and grit removal but ahead of the primary clarifier. It was felt that in an Aero-Accelator where the agitation was so intense, unsettled raw sewage could be handled; also the primary clarifier at the plant was operated at times with return activated sludge from the final clarifier and this would upset conditions in our pilot plant if we had used the primary effluent. In any case, it was desired to see how the Aero-Accelator would operate on unsettled but screened sewage.

The raw sewage flow and the air rate were at all times controlled at predetermined values. For any given rate of air supply the rate of recirculation in the Aero-Accelator was adjusted by a movable sleeve at the top of the inside tube so as to provide the desired circulation of slurry. The sludge that settled in the concentrator was periodically discharged through a timer controlled automatic diaphragm valve. The sludge wastage was so adjusted that the desired slurry concentration could be maintained, and also so that the slurry level in the outer zone never rose above the bottom edge of the outer tube. Thus, the concentration of solids in the circulating slurry could be controlled at any value desired up to some maximum value, by simply adjusting the timer on the sludge valve from the concentrator.

The pilot plant was operated practically continuously for a period of about four months and data were collected on B.O.D., suspended solids, air used, and suspended solids in the circulating slurry. (No data were collected on nitrification.) Samples were collected every two hours and composited for analysis over a 24-hour period. Unfortunately, the strength of the raw sewage during the period of pilot plant operation was extremely variable and many times varied in strength by several hundred per cent

from day to day. Of course, determining the influence of such variability on the Aero-Accelator was one purpose of the pilot plant tests.

In Fig. 3 there is shown, for over a two months' period, the B.O.D. of the raw sewage as it entered the Aero-Accelator and the treated effluent B.O.D. The values plotted are not the actual 24-hour composite sample B.O.D., but rather 5-day moving average values. This was done in order to iron out some of the extreme variations, but even so the raw sewage exhibited considerable variability.

In Table I the important data obtained from this pilot plant investigation are summarized; the values shown are for 24-hour composite samples from certain selected periods of operation when the Aero-Accelator was operating in a fairly stable manner after some change had been made in rate of flow, agitator speed, etc. The pilot plant was first operated at a rate of flow of raw sewage of 10.5 gpm. which gave a total retention time in the Aero-Accelator of about 3.7 hours. About 70 per cent of the volume of the Aero-Accelator was occupied by the circulating slurry. The effluent B.O.D. during the initial test period, as Table I shows, averaged about 25 ppm. It will be noted that during this initial period the suspended solids in the slurry were fairly low, rarely exceeding 1500 ppm. and many times below 1000 ppm.

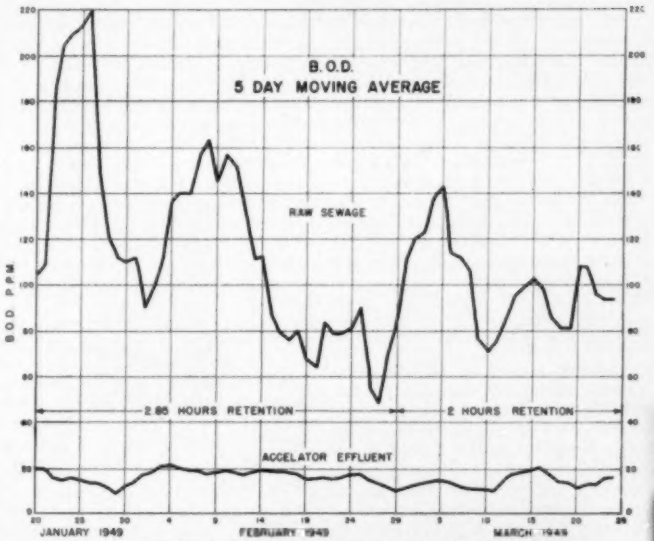

Fig. 3—Variation in B.O.D. of Raw Sewage and Pilot Plant Effluent

Later as the tests progressed and the throughput rate was increased, for instance to 13.6 gpm., it was felt that the suspended solids in the activated slurry would have to be increased if this higher organic load was to be handled properly. The effluent results indicate that the increased solids in the slurry not only permitted the handling of the higher throughput rates, even up to 19.7 gpm., (a total retention time of only 1.95 hours) but also improved the quality of the effluent appreciably. The total quantity of air used rarely exceeded 0.5 cu. ft. per gal. of sewage treated.

The writer has made studies relating to the use of calcium carbonate, either in precipitated or pulverized form, in the chemical treatment of sewage and certain oil-bearing industrial wastes (5). Since such treatment has proved fairly successful both in absorbing oils and greases and in removing suspended solids, it was decided to add a small amount of calcium carbonate to the activated slurry in the Aero-Accelator and see if any particular benefits would be realized.

In the latter part of Table I, data are shown for treating rates of 13.6 and 19.7 gpm. when 50 ppm. of calcium carbonate was added to the incoming raw sewage. The principal visual influence of the carbonate was that it gave a very fast settling, dense slurry which was capable of withstanding high agitation and circulation rates. The latter, of course, is quite desirable when it is realized that higher agitation speeds of the mechanical disperser permit better and quicker contacting of the incoming raw sewage and air with the activated slurry. It is noted from the data that when the calcium carbonate sludge was used the slurry index was usually appreciably below 100.

Table I

SUMMARY OF PILOT PLANT DATA

(24-Hour Composite Samples; P.P.M. Except Where Indicated)

Flow g.p.m.	Retention Hours	Air c.f.m.	Raw Sewage B.O.D.	Raw Sewage S.S.	Effluent B.O.D.	Effluent S.S.	Effluent O_2	Sewage Temp. °C	Slurry S.S.	Slurry Index No.
10.4	3.70	3.4	100	89	26	27	2.7	12	400	275
10.4	3.70	3.4	136	133	23	18	2.5	12	350	300
10.4	3.70	3.8	162	170	23	30	2.0	12	700	170
10.4	3.70	3.8	136	115	25	27	2.1	13	600	180
13.6	2.80	5.2	120	66	29	37	3.0	10	950	90
13.6	2.80	5.7	119	175	25	35	4.4	10	810	124
13.6	2.80	5.0	210	200	27	21	3.5	8	1970	81
13.6	2.80	6.3	130	126	27	35	2.0	7	1690	89
13.6	2.80	6.5	600	856	10	6	2.2	8	2080	72
13.6	2.80	6.5	230	200	21	25	4.7	9	910	88
13.6	2.80	5.8	213	320	9	24	6.0	9	1890	118
13.6	2.80	6.0	130	121	23	26	6.4	8	1000	80
13.6	2.80	6.5	123	79	21	27	5.8	8	860	93
13.6	2.80	7.0	190	259	22	28	6.8	9	1000	90
13.6	2.80	7.3	140	97	15	15	6.5	9	160	95
13.6	2.80	6.9	120	81	19	26	7.0	10	1370	102
13.6	2.80	7.8	203	132	23	47	5.8	10	1750	92
13.6	2.80	7.5	167	194	13	17	4.0	9	2800	110
19.7	1.95	6.0	90	74	9	9	4.8	10	3450	102
19.7	1.95	6.0	90	62	14	11	3.6	10	4390	128
19.7	1.95	7.0	75	85	10	5	2.5	10	4060	156
19.7	1.95	8.0	335	576	22	19	0	11	3100	164
19.7	1.95	8.0	86	61	18	14	2.6	11	3740	129
			In following tests 50 p.p.m. calcium carbonate added							
13.6	2.80	7.8	200	211	19	30	3.0	6	3500	90
13.6	2.80	7.8	100	52	16	29	3.5	6	4100	83
13.6	2.80	7.8	120	239	19	41	6.0	7	3400	56
13.6	2.80	6.5	113	58	25	40	9.0	7	3680	41
13.6	2.80	6.0	65	36	16	37	9.0	7	3980	38
13.6	2.80	5.8	104	63	17	22	7.0	7	3890	46
13.6	2.80	6.0	160	123	18	25	6.5	7	4760	61
13.6	2.80	5.0	146	204	10	40	4.8	7	8540	42
19.7	1.95	7.0	100	110	16	22	4.4	9	7600	62
19.7	1.95	6.0	97	23	12	18	5.2	9	7780	64
19.7	1.95	6.0	215	256	14	33	1.5	9	7530	80
19.7	1.95	7.0	90	100	13	11	2.3	9	7400	85
19.7	1.95	7.0	95	153	8	18	3.0	8	7800	87
19.7	1.95	7.4	88	43	12	15	1.0	9	5650	89
19.7	1.95	7.8	147	350	34	60	2.0	9	5030	91
19.7	1.95	7.8	120	90	22	45	3.5	9	4650	73
19.7	1.95	8.0	102	50	11	10	3.4	9	3080	123
19.7	1.95	8.0	160	146	15	27	2.0	9	4250	122

The calcium carbonate had considerable affinity for oil and greases and it was quite apparent that when it was being used there was no visual evidence of any grease or oil in any part of the Accelator. The dewatering characteristics of the sludge obtained from the Aero-Accelator when the carbonate was being used was considerably better than when it was absent. Though no measure of the proportion of calcium carbonate to organic solids was made for the slurry or the waste sludge, it is estimated that the ratio of sewage or organic solids to calcium carbonate in the circulating slurry was about 3:1.

One important item regarding the use of calcium carbonate was that during the period of its use at no time would the Aero-Accelator get upset, even though it received shock loads due to unexpectedly strong septic sewage, which had been standing in the mains and was suddenly pumped to the plant, or due to inadvertently not having sufficient air. There was no evidence of "bulking" at any time during the period of calcium carbonate use even under bad operating conditions. It appears that the use of calcium carbonate might be justified, irrespective of any other advantages, due to the fact that it gives the circulating slurry weight and body. It also has the ability to absorb greases and oils quickly so that operation of a plant, which may not have too close attention, would not be upset if conditions are not maintained exactly right at all times. In other words, it appears the calcium carbonate affords a good "buffering" influence so far as operation of the treatment plant is concerned.

This pilot plant installation afforded a convenient opportunity to try out the use of pure oxygen instead of air, and this was done for about five days of operation. The pilot plant was operated for a flow which gave a retention time of about 1.95 hours, similar to the maximum flow used with air, and no carbonate was used. In general, the effluent characteristics were similar to that when air was being used and it did not appear that appreciably greater flows could be handled with oxygen than were handled with air. The principal difference noted was in the excellent appearance of the slurry and its very good settling qualities. A sludge index of 100 was easily obtained and solids concentrations between 4000 and 5000 ppm. could be kept in the Aero-Accelator without any difficulty whatsoever. Otherwise, the use of oxygen did not provide any striking differences compared to air. It was found that the amount of oxygen that had to be fed in order to keep a comparable dissolved oxygen content in the effluent was about one-tenth of the volume of the air that was used. This is somewhat significant since the oxygen content of air is about one-fifth of the air volume. The conclusion to be drawn from the use of oxygen as compared with air is somewhat similar to that which can be drawn from the laboratory results obtained by Okun (*6*), in that the ability to maintain higher solids concentrations when using oxygen is the principal reason why higher treating rates can be used. So far as the Aero-Accelator is concerned, the conditions for oxidation that are maintained therein are such that for comparable dissolved oxygen contents in the slurry there is no striking difference between the use of air or pure oxygen insofar as effluent results are concerned or other operating characteristics.

Conclusions

The Aero-Accelator utilizes the well-known activated sludge process of treating sewage and wastes in a manner that is different from the conventional methods which usually in practice consist of a cyclic process of consecutive steps of mixing, aeration, and settling. In the Aero-Accelator the mixing of raw sewage and air with previously-formed biological solids and the separation of treated and clarified liquid from the slurry mixture is more or less a simultaneous unit operation.

The pilot plant Aero-Accelator which was operated at various rates up to 20 gpm. treating screened domestic raw sewage of somewhat below average strength, indicated that satisfactory B.O.D. and suspended solids reduction could be obtained for total retention times as low as 2 hours. This Aero-Accelator was of course replacing the primary clarifier, aeration basins, and final clarifier. The oxidation rate in this unit was accelerated and intensified due to the very excellent mixing and dispersion of the raw sewage, air, and biological solids that was obtained by using a specially designed mechanical disperser and compressed air.

Since the biological solids in this treating process are in continual and rapid circulation and are never allowed to settle, except a small portion which is eventually wasted, it was believed more appropriate to refer to the solids in the Aero-Accelator as an "activated slurry" instead of the ordinary term of "activated sludge." The concentration of the activated slurry can be readily controlled to suit the particular treatment conditions. Since compressed air and the raw sewage are mechanically dispersed the aeration and mixing features can be independently varied and controlled.

Some tests were made in this pilot plant feeding precipitated calcium carbonate, which was a waste sludge from a water softening plant, in order to determine the influence of the calcium carbonate on the activated slurry in the treating process. The use of the calcium carbonate permitted maintaining a much heavier solids concentration and improved the settling qualities of the slurry so that shock loads on the plant were more easily handled. The calcium carbonate appeared to have an excellent buffering influence chemically and physically.

Tests were made with this pilot plant using pure oxygen instead of air, and when maintaining a similar dissolved oxygen content in the treated effluent the operating characteristics of the Aero-Accelator were generally similar to that when air was used. However, the use of the pure oxygen did improve the physical quality of the activated slurry in that it was quite easy to maintain a high concentration of solids, and the settling qualities of the solids seemed to be better than when air was used. It did not appear that the capacity of the unit could be appreciably increased when using oxygen over that when air was used. Of course, maintenance of an exceedingly high dissolved oxygen content might enable higher treating rates, but this would not be economical since too much of the oxygen would be wasted with the effluent.

Pilot plant studies with the Aero-Accelator are now being continued at other localities where the sewage characteristics are somewhat different from those at Elmhurst; also, several plant-scale Aero-Accelators are now in the process of being engineered and installed. It appears quite definite that the Aero-Accelator should afford an economical and simple method of treating sewage and wastes by aerobic biological oxidation.

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B.O.D. OR C.O.D.—A COMMENTARY

by

GEORGE A. RHAME*
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TO the writer the whole of the present controversy concerning the relative merits of the B.O.D. and C.O.D. determinations is stranded on the fact that as generally performed they do not measure the same thing. The standard B.O.D. test[1] as a measure of sewage strength only determines that portion of the oxygen demand of a sample of sewage or trade waste which is exerted in five days by the action of the random combination of biological growths which happen to be present in the dilution bottle. Results of replicate determinations, especially when small portions are used for each dilution bottle, are notably erratic. Such results are to be expected in the light of reports showing the irregular distribution of bacteria in sewage and the effects of such irregularity.

Lederer and Bachmann[2] found that identical portions of sewage taken at intervals of one minute for ten minutes gave total bacteria counts ranging from 190,000 to 550,000 per ml. The obvious corollary that the rate of oxidation is dependent upon bacterial numbers was quantitatively demonstrated by Butterfield and Wattie[3], who also showed that the rate of oxidation was influenced by the degree of dispersion of bacteria or bacterial flocs with adequate dispersion being necessary for rapid oxidation. Superimposed upon these considerations is the obvious fact that the solids in sewage are not uniformly distributed.

First Stage Oxygen Demand

A chemical oxygen demand test can be, and generally is (except where permanganate is used) set up to measure the oxygen demand of *all* of the material present which is of such a nature as would be oxidized during the "first stage" of biological oxidations. Although subject to the errors caused by the non-uniform character of sewage, C.O.D. methods have the advantage of being easily adjusted to test substances having very high demands, which cause trouble in the B.O.D. test due to the very high dilution ratios required.

The obvious solution to this difficulty would be to run oxygen demand studies to completion of the "first stage" demand. This would eliminate the more serious conflicts immediately and contribute to the solution of many other problems as will be discussed later.

The Author

Determination of total first stage demand by dilution methods has many practical drawbacks. The methods generally used in research work[4,5,6,7] require so many daily ovygen demand determinations and such extended mathematical treatment as to be useless for ordinary purposes. A method recently developed by Churchill[8] greatly reduces both the laboratory work and the mathematics of such studies. The method presented by this writer[9] is even simpler, but has been "stripped down" to the point that precautions must be taken to eliminate both "lag" and nitrification during the incubations. While using the latter method it was found necessary to use seeded dilution water with raw sewage to insure elimination of the lag period, but not when testing settled sewage. Nitrification may be eliminated by pasteurization[10], acidification[11] or addition of 2 ppm. chromate ion to the dilution water[12]. These shorter methods could be managed by most sewage treatment plant laboratories as they would require the use of only about three times the number of incubation bottles normally used for 5-day B.O.D. work.

Studies of the oxygen demand of a great maany trade wastes by dilution technics will probably never be completely successful because of variations in their chemical availability and toxicity to the sewage seeding material which must be used with most of them. The special or "acclimatized" seed which is frequently used sets up conditions so artificial as to make the relation between laboratory studies and actual treatment or disposal conditions a matter of doubt.

Chemical Oxygen Demand

Turning to the Chemical Oxygen Demand test we find that after some years of confusion there is reason to expect an early resolution of most of the difficulties. (Perusal of the literature suggests that much of this confusion has resulted from attempts to compare C.O.D. results with the 5-day B.O.D.) Only recently have investigators begun to coordinate the C.O.D. test with total first stage demand. A point has been reached where comparable results can be obtained by widely varying technics. That it should always be necessary to have available more than one procedure in order to handle all types of sewages and wastes is inevitable; it is only necessary that they be directed towards a common end. A report by W. A. Moore[13] on comparison of C.O.D. methods shows good correlation in results by the methods of Ingols and Murray[14] and the U. S. P. H. S.[15] and a somewhat higher divergence for the Iodate[16] method (which, however, seems somewhat more suitable for wastes containing much volatile matter).

Carbonaceous Oxygen Demand

There seems to be a growing awareness of the great importance of carbonaceous oxygen demand, as indicated by more or less speculative remarks in the course of various demand studies, but so far little has been reported of efforts to make direct studies of the problem. An article by Eliasson[17] showed some of the more important factors some years ago. He brought out the fact that where it is desired to maintain sufficient dissolved oxygen in a stream for the support of fish, the oxidation-reduction potential is such that nitrites, nitrates and sulfates can not function as oxidizers. Since it is a well-established fact that the second stage of oxygen demand is normally exerted at a much lower rate than the first stage this factor may be generally expected to have little effect on receiving stream conditions. When necessary, this nitrogenous demand may be readily calculated from analytical procedures already available.

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As has been frequently demonstrated, the rate of oxidation achieved in dilution B.O.D. methods is comparatively low. Obviously the rate of oxidation in a treatment plant using biological methods is many times greater, so that very nearly the entire carbonaceous demand must be satisfied during the time of passage of the sewage through the treatment plant. Such being the case, the unknown fraction of the total demand which is represented by the 5-day B.O.D. is of little specific value in predicting treatment plant reaction to the demand load. The methods available for eliminating the onset of nitrification in the dilution bottle[9, 11, 12] would improve the situation somewhat if generally used in plant control, but would still suffer from random variations in the oxidation rates of sewage, both raw and treated. (That some of the oxygen demand load is removed mechanically in the treatment plant by sedimentation, or otherwise, does not affect the general premise—and in some plants such mechanical removal is affected only after the oxidation process.)

Upon consideration of the stream which is to receive a contribution of sewage or industrial waste, whether treated or not, we find a similar situation as regards oxygen demand rates. It is well established that demand rates are influenced by depth, turbulence and velocity of flow. Kittrell and Kochittzky[13] have shown that in a shallow, turbulent stream this rate approaches that of a treatment plant. The major problem in pollution control work is that of calculating how much sewage or waste a stream will be able to absorb while maintaining its dissolved oxygen above some specified lower limit or how much load must be removed in order to maintain this minimum. Until recently this was a problem of such difficulty that engineers largely relied on empirical methods to arrive at an approximate result. A solution may now be arrived at comparatively easily by the nomographic solution of Streeter[14] or the mathematical treatment of Thomas[15], the only catch being that both involve, as the fundamental load factor, the total oxygen demand.

Three Fundamental Problems

From the foregoing it appears to the writer that the three fundamental problems in water pollution work—the nature of sewage and trade wastes, the treatment of the same, and the reaction of the treated or untreated material in the receiving stream—have as a common primary factor the total first-stage, or carbonaceous, oxygen demand of the material being studied. If this be so, it is then logical that we should endeavor to perfect analytical methods which will enable us to make use of this factor to unify our concepts of various aspects of the problem whose interrelation is at present none too well defined.

Since the work of various investigators reported within the last few years makes it fairly clear that methods for C.O.D. will be able to determine first-stage demand quite readily, they would be highly advantageous for routine work due to the reduction in time and material required. Note, however, that as our treatment plants and receiving streams are essentially biological mechanisms, dilution and/or direct oxygen absorption technics should be adhered to as primary standards wherever possible.

When the toxicity factor of an industrial waste is to be evaluated the C.O.D. test is of no benefit and the B.O.D. test would be of little value in routine operations. Quite informative technics have been presented by Heukelekian[16] but it might easily take many days to properly evaluate the toxic properties of a waste by his procedure of comparing the B.O.D. values obtained at different dilution ratios. Use of both dilution bottle and direct absorption methods is suggested in order to extend the range of concentrations. An alternative is offered by Anderson's[17] method of comparing the concentration of the substance being studied and the time required for immobilization of *Daphnia Magna* placed in it. The procedure is relatively simple, inexpensive and rapid and could easily be used even in the smaller laboratories.

The recent paper by Ingols[18] and associates offers some interesting insight into the history of efforts to develop a suitable C.O.D. test as well as some discussion of the difficulties connected with the dilution B.O.D. This writer found the comments on methods of eliminating nitrification in the dilution bottle particularly informative because of the reference to the work of Placak, Ruchoft and Snapp[19] which showed that nitrification could be eliminated by the presence of 2 ppm. of Chromate ion. This procedure could be carried out much more conveniently than those previously proposed and would have the great advantage of eliminating the possibility of nitrifiers developing in the seeding material—in many cases seeding would not be needed at all.

Ingols' observations on the effect of using a Waring Blender on raw sewage samples are curious. If, as has been indicated above, the oxygen demand is a function of bacterial content, then the evidence of reduced 5-day B.O.D. and increased bacterial numbers are apparently contradictory. A scrutiny of Ingols' data indicates that four results of B.O.D. determinations on raw and blended sewage are at wide variance one with the other. (In samples 4, 14, 17, and 18 the blended sewage B.O.D. results differ from the unblended results by 115, 107, 185, 114 ppm. or −54%, +34%, −37.5% and −23%.) If these results are omitted from the tabulation then the average results for 19 samples are 217 and 213 ppm. respectively for raw and blended sewage. Perhaps then blending did not have the effect on B.O.D. which Ingols indicated and inasmuch as no actual data were presented on the "four or five" bacterial observations it may be unwise to generalize that the B.O.D. data and bacterial results on blended samples are contradictory.

The comparative results reported by Ingols on analysis of the blended samples by an outside laboratory are baffling (because of the high *degree* of divergence of results). The results would have been more informative had they been carried to total first-stage demand. It is possible that some local factors had caused a variation in the rate of oxidation only. They do have the valuable function of pointing up the fact that the numerous uncontrolled factors in the 5-day B.O.D. as usually performed considerably reduce its significance. Either set of results, by itself, would ordinarily be considered valid, but consider the possibilities if, for instance, the low results were used as the basis of design of an activated sludge plant and it should eventually be found that the high ones were a better approximation of the actual plant load.

The writer became interested in the problem of the development of a chemical oxygen demand test when, as a sewage treatment plant operator, he became convinced that plant performance could be improved by use of some analytical procedure which would make sewage strength data immediately available. It was only after considerable blundering around that it was found that the C.O.D. test would be reliable only on a total first-stage demand basis—which led to studies which convinced him of the logic of such an approach. He holds no particular brief for the C.O.D. test so arrived at except that, in line with the original idea of using it for plant control, it is much more rapid and requires much less equipment than any other of which he is aware.

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SPECIAL TOOLS FOR SPECIAL WORK*

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Cutting Piling with Pneumatic Saw Operating Under Water

In the extension of an 84-inch corrugated storm drain out through beach sands for discharge at tide level, it was necessary to remove piling and tongue and groove sheeting which had been placed as a protection against wave action. At the location where the corrugated storm-drain pipe had to be connected to the existing wooden structure some piling and sheeting had to either be jetted out or cut off at the proper grade.

It was found that the jetting of such old piling and sheeting would cost more than any value that might be salvaged by such method. It was also found that the use of a cross-cut manually operated saw was slow and costly. It was impossible to use an electrically operated saw, due to the danger of electrical shock while working in water.

A special pneumatic cross-cut saw was used to remove the piling and tongue and groove sheeting. This pneumatic tool works with 100 pounds of compressed air and operates *under water* when necessary. More than 100 feet of piling and tongue and groove sheeting was removed in record time and made it possible to lay 280 feet of 84-inch pure iron corrugated pipe in five days, which eliminated the hazardous condition endangering persons using the beach for recreation and bathing purposes.

The pictures show the use of the pneumatic air-operated chain-saw, which was found excellent for working in water and damp places under ground. The use of modern equipment to speed up work and reduce cost is essential in these times.

*Contributed by Reuben F. Brown, Supt. of Sewer Maintenance and Operation, Los Angeles.

Horace Clark Moves Engr. Office

Horace L. Clark, Consulting Engineer in the field of water works and civil engineering, has moved his offices from Sanford, Me. to Alfred, Me. His new offices will be located on Saco Road in the center of the town and opposite the Library.

Mr. Clark was Superintendent of Water at Sanford, Maine, for a number of years before entering consulting engineering practice.

Chlorine Test Kit Wins N.Y. State Prize Money

Richard C. ("Dick") Gorman, district sanitary engineer of the N.Y. State Dept. of Health at Hornell, N. Y., has been awarded $125 prize money for his contribution to the advancement of water treatment and public health.

The award was made by the N. Y. State Employee's Merit Award Board for a "Field Kit for Residual Chlorine Testing" conceived, designed and constructed by Mr. Gorman.

ON WRITING SPECIFICATIONS

An Open Letter from One "Super" to Another*

Dear "Tom"—

Sure enjoyed your recent letter about the article you are writing for *Water and Sewage Works* on buying water and sewage plant equipment. I think it's a swell idea and hope you'll go ahead with it because buying equipment is a subject so important that I think it ought to be discussed at every opportunity. We've all had trouble at one time or another getting stuck with something that wasn't what we wanted, and if we can exchange ideas on how to avoid these situations in the future it will certainly be a help.

As a matter of fact, I think you could write the whole paper just on your first point, that is, how to write specifications. You know, as well as I do, that writing good specifications is a tough job. You have to try to specify what you want and still keep everybody happy. True enough, this often results in complications; and, I had an interesting experience just the other day which will illustrate what I mean.

A few days after getting your letter I had to buy a new lock for the tool shed that's out by the elevated tank. While I was in the hardware store I was impressed by the number of different kinds of locks they carry; so, just out of curiosity, I started pricing some of them. As you can imagine the prices were all over the lot depending on what kind of lock it was and who made it. I was just buying an ordinary brass padlock and there was no red tape, since this is considered a petty-cash item, but I got to thinking about all those locks and how they varied so much in price even though most of them were sold to do the same job. Well anyway, that weekend it rained and while I was just sitting around the house, feeling mad that I couldn't be out fishing, I decided to try an experiment. I was thinking—just suppose I had to order a lock by mail, without first seeing it, what kind of a specification would I use.

A Sample Specification

I sat down and wrote out one of those so-called "functional" specifications to cover a padlock. I won't try to quote you everything put into my specification but briefly it went like this:

"The lock to be furnished shall be of the type commonly known as a padlock in which a shackle shall be pivoted on one end of the body and shall have a notch or recess on the other end which can be engaged in an appropriate opening on the side of the body opposite the pivot. When thus engaged the shackle and body shall form a loop which can only be opened by turning a key in the lock body to release the free end of the shackle. When open the lock shall be of such a size that the shackle can be passed through a staple or chain having an opening ½" in diameter. The lock shall be guaranteed against defects in material and workmanship for a period of one year and shall be of such construction as to be suitable for outdoor use. In a closed position the lock shall withstand a pull on the shackle of 250 pounds. Two keys for operating the lock shall also be furnished."

I had some other generalities in the specification but that's the substance of it. Well, of course you and I know that isn't a good enough specification to get what you want, but it's about the kind we often have to work with. Just as a gag I took it around to a number of lock suppliers to get "bids."

At a small hardware store I found four different locks that on the face of it would meet my specification. They were all good locks and about equal in price. Then I found two in a Dime Store which were much cheaper and while I felt they weren't satisfactory for my use they would still meet the specifications. Then just to top it off I asked a tool maker friend of mine if he would make a lock to meet my specifications and he said sure—for about $100. This got to be quite a joke around town and at lodge meeting the other night Bill James, the jeweler, even said he could make me one of solid gold for $1000, and still meet the specification.

The point of all this of course is that I got bids ranging from about 49 cents to $1000 on a specification that was just as good as many of the "functional" specifications that are used every day. Of course two of the "bids," while meeting the specifications, obviously gave more than was expected—simply because the specifications were not exact enough. As to the others, if I had really been taking bids I'd probably be stuck with the 49 cent job because it was the cheapest; and, as we've heard so many times, "it meets the specifications" even though I am confident it wouldn't have been satisfactory. Sure, people can say send it back and get it repaired or fixed under the guarantee, but even if it works that way (and lots of times for one reason or another it doesn't), I will have wasted more time than the thing is worth and my tool shed would be without a lock in the meantime. We'd probably just have to get along as best we could 'till it was propitious to buy another one, and hope the taxpayer didn't notice how his money was wasted on inferior goods.

On the Other Hand—

On the other hand, if my specification had been properly descriptive of exactly what I wanted—had named names, if necessary, and had been written *after* I'd investigated to find out just what I needed—I might have gotten only a few bids (maybe only one) but it would have covered the thing I wanted to buy and in the long run the taxpayer would have gotten a better deal and I'd have been much happier, realizing that I had gotten a dependable article.

Now don't get me wrong, I'm not saying not to take bids—that's the only fair way to do it—but, I am saying that you only get what you pay for in this world as a rule, so why not specify *exactly* what you want and stop kidding yourself—and the taxpayer—wtih a lot of specifications that really say very little of anything.

Some of our commissioners heard about my little joke and I think maybe it had some effect—I hope so anyway and I hope maybe it'll give you some help on your article, Tom. I'll see you at the Section meeting next month and will be looking forward to having a chat with you.

Yours, for better specifications,

"Bill"

*Ed Note: This is one of the "Open Letters from One Superintendent to Another," such as we ran a series of a few years back. It has been suggested that we again start these "Dear Bill" or "Dear Tom" letters. If you have a pet peeve, a "gripe" or a suggestion which you think will help a fellow operator, why not put it in the form of one of these "Dear Bill" letters. You may not wish your name used with the letter; if so we will respect your wish—but the more of these "Open Letters" the better.

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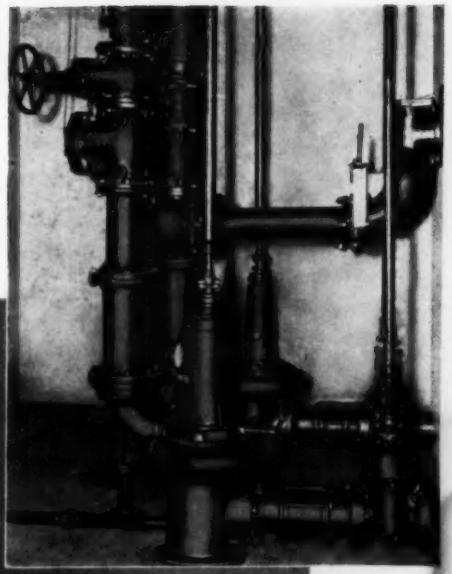

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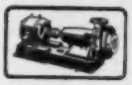

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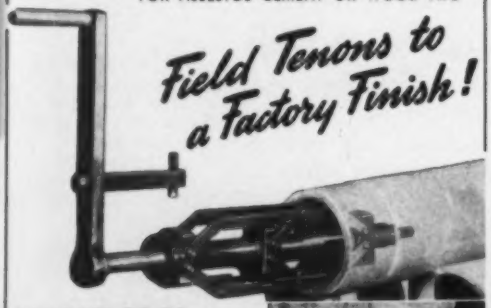

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Seattle 14, Wash.

MEETINGS SCHEDULED:

APR. 3-5—NIAGARA FALLS, ONTARIO (General Brock Hotel)
Canadian Section A.W.W.A. Sec'y, Dr. A. E. Berry, Parliament Buildings, Toronto, Ont.

APR. 4-7—ST. LOUIS, MO.
National Association of Corrosion Engineers. Sec'y, A. B. Campbell, 919 Milam Bldg., 803 Texas Ave., Houston, Texas.

APR. 12—SKOWHEGAN, MAINE
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

APR. 12-14—CHICAGO, ILL. (LaSalle Hotel)
Illinois Section A.W.W.A. Sec'y, Carl N. Brown, U. S. Pipe & Foundry Co., 122 So. Michigan Ave., Chicago, Ill.

APR. 13-14—LINCOLN, NEB. (Cornhusker Hotel)
Nebraska Section A.W.W.A. Sec'y, J. W. Cramer, 922 Trust Bldg., Lincoln 8, Neb.

APR. 17-19—LITTLE ROCK, ARK. (Robinson Memorial Auditorium
Arkansas Water & Sewage Conference. Sec'y, Prof. Harrison Hale, 118 Chemistry Bldg., Fayetteville, Ark.

APR. 19-21—SALINA, KANSAS (Lamar Hotel)
Kansas Section A.W.W.A. Sec'y, Harry W. Badley, 640 Highland, Salina, Kans.
Kansas Sewage Works Association. Sec'y, Dwight F. Metzler, State Board of Health, Room 2, Marvin Hall, Univ. of Kansas, Lawrence, Kans.

APR. 20—NEWPORT, R.I. (Hotel Viking)
New England Water Works Association. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston 8, Mass.

APR. 20—MISSOULA, MONT. (Florence Hotel)
Montana Sewage Works Association. Sec'y, H. B. Foote, State Board of Health, Helena, Mont.

APR. 21-22—MISSOULA, MONT. (Florence Hotel)
Montana Section A.W.W.A. Sec'y, C. W. Brinck, State Board of Health, Helena, Mont.

APR. 26-28—LAFAYETTE, IND. (Purdue University)
Indiana Section A.W.W.A. Sec'y, C. H. Bechert, 445 N. Pennsylvania, Room 200, Indianapolis 4, Ind.

APR. 27-28—CUMBERLAND, MD. (Ft. Cumberland Hotel)
Maryland-Delaware Water and Sewerage Assn. Sec'y, W. McLean Bingley, 2411 No. Charles St., Baltimore, Md.

APR. 28—PATERSON, N.J. (Y.M.C.A.)
North Jersey Water Conference. Sec'y, H. N. Lendall, 26 Clifton Ave., New Brunswick, N. J.

MAY 3-6—LONG BEACH, CALIF. (Lafayette Hotel)
California Sewage Works Association. Sec'y, Lawrence H. Cook, P. O. Box 696, Menlo Park, Calif.

MAY 10—TACOMA, WASH. (Winthrop Hotel)
Pacific Northwest Sewage Works Association. Sec'y, W. P. Hughes, City Hall, Lewiston, Idaho.

MAY 11-13—TACOMA, WASH. (Winthrop Hotel)
Pacific Northwest Section A.W.W.A. Sec'y, O. P. Newman, Boise Water Corp., Boise, Idaho.

MAY 19—PITTSFIELD, MASS. (Hotel Sheraton)
New England Water Works Association. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

MAY 21-26—PHILADELPHIA, PA.
American Water Works Association (Annual convention). Executive-Secretary, Harry E. Jordan, 500 Fifth Ave., New York 18, N. Y. (Meetings & Exhibits in the Auditorium.) All reservations will be cleared through the A.W.W.A. Headquarters.

MAY 22-24—TRAVERSE CITY, MICH. (Park Place Hotel)
Michigan Sewage Works Association. Sec'y, D. M. Pierce, State Dept. of Health, Lansing 4, Mich.

JUNE 5-10—GAINESVILLE, FLA. (Univ. of Florida)
Florida Annual Water & Sewage Short School. Director, David B. Lee, P. O. Box 210, Jacksonville, Fla.

JUNE 6-8—AUBURN, ALA. (Alabama Polytechnic Institute)
Alabama Water & Sewage Works Association. Sec'y, Alex O. Taylor, Alabama Polytechnic Institute, Auburn, Ala.

JUNE 9-10—INDIANAPOLIS, IND. (Hotel Lincoln)
Central States Sewage Works Association. Sec'y, Paul W. Reed, 1098 W. Michigan St., Indianapolis 7, Ind.

JUNE 12-13—JAMESTOWN, N. Y. (Hotel Jamestown)
New York Sewage and Industrial Wastes Assn. (Spring Meeting) Sec'y, R. C. Sweeney, 119 E. Main St., Rochester, 4, N. Y.

MEETINGS SCHEDULED:

JUNE 14—KITTERY, MAINE
Maine Water Utilities Assn. Sec'y, Earl A. Tarr, Supt. Water District, Winthrop, Me.

JUNE 28-30—CINCINNATI, OHIO (Gibson Hotel)
Ohio Sewage & Industrial Wastes Treatment Conference. Sec'y, G. A. Hall, 302 Dept. of State Bldg., Columbus, Ohio.

JUNE 29—DOVER, N. J. (Germania Park)
New Jersey Section A.W.W.A. (Clambake and Outing). Inspection Trip, Lock Joint Pipe Co., Wharton, N. J. Sec'y, C. B. Tygert, Box 178, Newark, N. J.

AUG. 9—MT. DESERT ISLAND, ME.
Maine Water Utilities Assn. (Summer Meeting) Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

AUG. 20-22—STATE COLLEGE, PA. (Nittany Lion Inn)
Pennsylvania Water Works Operators Assn. Sec'y, Prof. Robert E. Stiemke, Dept. of Engineering, State College, Pa.

AUG. 23-25—STATE COLLEGE, PA. (Nittany Lion Inn)
Pennsylvania Sewage & Industrial Wastes Assn. Sec'y, B. S. Bush, Penna. Department Health, Kirby Health Center, Wilkes-Barre, Pa.

SEPT. 7-8—SARANAC LAKE, N. Y. (Saranac Inn)
New York Section A.W.W.A. (Fall Meeting) Sec'y, R. K. Blanchard, 50 West 50th Street, New York, N. Y.

SEPT. 17-21—POLAND SPRING, ME. (Poland Spring House)
New England Water Works Association. (Annual Convention) Sec'y, Joseph C. Knox, 204 Tremont Bldg., Boston, Mass.

SEPT. 19-21—DAVENPORT, IOWA (Hotel Blackhawk)
Iowa Sewage Works Association. Sec'y, Leo Holtkamp, E. Ohio Street, Webster City, Iowa.

SEPT. 26-29—ATLANTIC CITY, N.J. (Claridge Hotel)
Pennsylvania Water Works Association. Sec'y-Treas., C. M. Hartman, 510 Telegraph Bldg., Harrisburg, Pa.

SEPT. 27-29—SANTA FE, N. MEX. (LaFonda Hotel)
Rocky Mountain Sewage Works Association. Sec'y, C. H. Coberly, Room 329, 1441 Welton St., Denver, Colo.
Rocky Mountain Sect. A.W.W.A. Sec'y, Geo. J. Turre, Room 120, City-County Bldg., Denver, Colo.

OCT. 1-3—ST. LOUIS, MO. (Sheraton Hotel)
Missouri Water & Sewage Conference. Sec'y, Warren Kramer, State Office Bldg., Jefferson City, Mo.

OCT. 9-12—WASHINGTON, D.C. (Statler Hotel)
Federation of Sewage Works Associations. Exec.-Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

OCT. 11—WATERVILLE, ME.
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

OCT. 15-18—NEW ORLEANS, LA. (Roosevelt Hotel)
Southwest Section A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

OCT. 24-27—SAN DIEGO, CALIF.
California Section A.W.W.A. (Annual Meeting) Sec'y, Wm. W. Aultman, Box 38, LaVerne, Calif.

OCT. 26-28—ATLANTIC CITY, N.J. (Hotel Madison)
New Jersey Section A.W.W.A. Sec'y, C. B. Tygert, P. O. Box 178, Newark, N. J.

NOV. 6-7—RICHMOND, VA. (Jefferson Hotel)
Virginia Section A.W.W.A. Sec'y, W. H. Shewbridge, 713 State Office Bldg., Richmond, Va.

NOV. 13-15—DURHAM, N.C. (Washington Duke Hotel)
North Carolina Section A.W.W.A. and North Carolina Sewage Works Association. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N. C.

NOV. 13-15—FT. LAUDERDALE, FLA. (Governor's Club Hotel)
Florida Section A.W.W.A. Sec'y, A. E. Williamson, Jr. P. O. Box 1431, Daytona Beach, Fla.

NOV. 16—BOSTON, MASS. (Hotel Statler)
New England Water Works Assn. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

NOV. 17-19—MESA, ARIZONA
Arizona Sewage & Water Works Association. Sec'y, Helen Rotthaus, San. Eng. Div., State Capitol, Phoenix, Ariz.

DEC. 21—BOSTON, MASS. (Hotel Statler)
New England Water Works Assn. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Electroforged into one piece
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Self-cleaning • Easily Maintained • Maximum open area • Simple to cut and bend for fitting around obstacles • Adaptable to many uses.

Blaw-Knox Electroforged Stair Treads available with rolled diamond checker plate nosing, twisted crossbar nosing or abrasive nosing.

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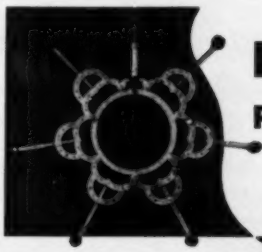

The New Model 4 PILOT PIPE CUTTER for Asbestos—Cement and Clay Pipe

—Easy to Use
Saves time and money

Pays for itself *on the job.* Simply drop on to the pipe, snap one point together . . . and you are cutting pipe — fast. There's always another handle within easy reach. Stays sharp ...up to 1000 cuts per blade sharpening.

PIPE CUTTER
Model 4 — Basic Unit
Range 3½"—8" O.D.

Wide Range: The basic unit of the Pilot Pipe Cutter handles all classes of 3", 4" and 6" pipe (3½" through 8" O.D.) Range can be increased up to 20" pipe in all classes (25" O.D.)
Light weight: just 16 pounds.

$56 freight added

Handle assemblies for increasing capacity . . . only $14.00

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Now you can MACHINE Pressure Pipe in the field, too. Ask your supplier about the new Pilot Machining Tool

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CHECK THESE ADVANTAGES

OF CARLON PLASTIC PIPE*

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- Flexibility
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* CARLON PLASTIC PIPE is the modern answer to water and sewage transmission problems. *Guaranteed forever* against rot, rust, and electrolytic corrosion, it has a trouble-free service life many times longer than ordinary pipe.

CARLON'S flexibility and extreme light weight provide for more rapid and economical installation. One man can lay long sections easily and then make connections in two minutes. Many fittings necessary for other pipe are completely eliminated.

CARLON will curve to follow a ditch line or surface contour, and it can be installed above or below frost level because its ratio of expansion exceeds that of freezing water.

Write today for additional information, or call BRoadway 6565 for immediate service.

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STD. SIZE	O. D.	I. D.	CALCULATED B. P. P. S. I.	WT./FT.	NORMAL SHIPPING LENGTHS
1/2"	0.840	0.622	540 lb.	0.103 lb.	400 ft. coils
3/4"	1.050	0.824	330 lb.	0.140 lb.	400 ft. coils
1"	1.310	1.070	200 lb.	0.181 lb.	300 ft. coils
1 1/4"	1.660	1.380	200 lb.	0.267 lb.	300 ft. coils
1 1/2"	1.900	1.610	200 lb.	0.320 lb.	250 ft. coils
2"	2.378	2.078	170 lb.	0.445 lb.	200 ft. coils
3"	3.504	3.078	165 lb.	0.91 lb.	100 ft. coils
4"	4.504	4.026	150 lb.	1.25 lb.	25 ft. str.
6"	6.630	6.070	115 lb.	2.23 lb.	25 ft. str.

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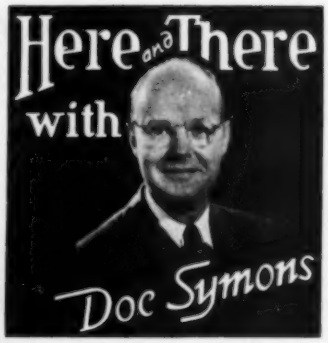


H.T.M.A.—On a very cold March 2, thinking about May and the AWWA Convention in Philadelphia—among other things—But to get back to the present—

Before I forget it—I'm short several needed copies of the October 1949 number of W & S W. I know that some of you folk save only the annual Ref. and Data number, so when you throw out the other eleven issues, throw that October number in my direction—I'll send you the postage in return, with my sincere thanks.

[More than this—we will extend your subscription a full two months.—Ed.]

* * *

Death rewrites a paragraph—Last month when preparing the March column, I wrote a few extra items, as I sometimes do. The extras that would keep, I held back for this month. One of them concerned the late C. C. Agar; it was a humorous addition by "Charlie" to the story of the correspondence between him and Joe Gilbert. What prompted me to hold that particular item, I'll never know, but it wouldn't fit now.

Some of you may have wondered why I always called Charlie "Pops." We first met in the autumn of 1937 in Elmira, N.Y., at a meeting of NYSSWA. We were thinner then, had mustaches trimmed alike, and hair—or some semblance of it—of the same color. Some one asked if we were brothers, to which "Charlie" replied, "He's my son!"—He was "Pops" thereafter—I remember the time we were the only two "sewage" men at a convention of the N.Y. Section AWWA and stole the headlines in the local newspaper with a front page photograph of the two of us, in the rain, under a huge umbrella on the hotel fire escape, with the caption, "What Else Could Visiting Water Experts Expect"—So long "Pops!"

* * *

Bridge game in Milwaukee—C. C. (Jeff) Abplanalp of W&T's Chicago

office is ready to trump the card that Leon Smith, (Madison's Water Supt. and Secy. Wis. Sect. AWWA) is playing with that ghost-like left

hand. "Jeff's" partner—the debonair Secy. of the Illinois Sect. AWWA, Carl N. Brown of the U.S. Pipe Browns. Bystanding kibitzer—Larry Lingnor, once a W & S W Salesman in Chicago and now owner of the Chemical Specialties Co. in Milwaukee.—And—Sorry but I can't remember Leon's partner's name.—I didn't stay to learn who won, but next day Carl Brown bought me a tie pressing gadget and I know that didn't go on his expense account.—Oh yes; scene was Hotel Schroeder at the Wisconsin Sect. meeting last October.

* * *

Wonder what ever happened to Arthur B. Morrill who was in China with WHO? Last I heard from him was a year ago when he wrote giving three reasons why he hadn't written for some months. The third went as follows—"I am a little sore at you for falling so easily for the blandishments of them hucksters. It is getting so that they have more space in H & T than the chemists, engineers, professors, and other blameless people. The theory is this, George: These peddlers earn so much money at their trade that by Emerson's philosophy of compensation, they must be abused some way or other. This the poor underpaid chemists do by only allowing the hucksters to be associate members of their organizations. They, the peddlers, should not actually be insulted, but they should generally be given the stiff arm unless it is a matter of paying a restaurant check or contributing to a fund for a tap room at the annual convention. The way you have been welcoming these fellows into 'Here and There' is going to break down discipline. . . ."

I guess Art is **really** mad at me or maybe the Chinese Communists have him in Nanking, because I haven't heard from him since.

* * *

Lucky George—It must be wonderful to have a two week paid winter vacation in Florida as did George W. Kelsey (Builders' V.P. & Gen. Sales Mgr.) If I know my Georges, this one is working even if he's on a vacation.

CLARK METER BOX COVERS
For Concrete and Tile

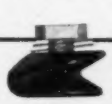
Complete, Economical Protection

Above, A-2-13 Clark Meter Box Cover with screw lock. Height 4" lid opening 13"

Left, A-2-11 Clark Single Lid Meter Box Cover, 4" throat. Also available in 6" and 9" throat.

Right, B-2-11-L Clark Double Lid Meter Box Cover, 6" throat. Also available in 4" and 9" throat.

The many types and sizes of Clark Meter Box Covers permit easy selection for any particular use. Careful design and rigid manufacturing processes assure permanence and protection against replacements. Standard Clark Covers withstand periodic load tests of 11,200 to 13,500 pounds, while extra heavy types withstand 21,400 pounds. All Clark Covers give complete protection to the meter. Available in sizes to fit 15" to 24" drums. Wonder Lock and screw lock covers available in 4" throat only.



Improved Screw Lock with strong forged bronze bolt.

Perfect Lock of one-piece manganese bronze forging.

Wonder Lock Lid (bottom view) showing forged bronze bars. Key of forged steel, cadmium plated.

Combination Key, available in meter and service box sizes.

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When you have a job of handling gas or air, in quantities from 5 cfm to 100,000 cfm, Roots-Connersville will do it efficiently and economically. With many sizes and types, we can match blowers, exhausters and gas pumps closely to the job, to reduce first cost and operating costs.

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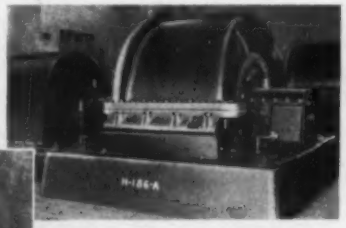
Three Centrifugal Blowers in large eastern sewage treatment works. Capacity 15,000 cfm each.



Rotary Positive Blower used in water filtration application. Capacity 470 cfm.

ROTARY

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ONE OF THE DRESSER INDUSTRIES

one is working even if he's on a vacation.

* * *

Sometimes when I work at home I hear Arthur Godfrey's radio program.—I'm not the only one either. Paul Timme, Badger Meter representative in Lodi, N.Y., tunes in while making trips from one city to another to sell his wares. Timme got a little fed up with the opening announcement of Godfrey's about how Glasswax "Cleans 30 kinds of dirt in 30 seconds," and wrote the ebullient Arthur to point out that nobody wanted clean dirt, whether it was cleaned in 30 seconds or 30 minutes. Timme thought Godfrey should say "removes 30 kinds of dirt in 30 seconds" but CBS' favorite boy just laughed—He's no purist, Paul.

* * *

Small World No. 11—The week before Christmas, I passed through Chicago on my way to Mt. Morris, Ill., where this mag. is printed. Between trains I was browsing in the Fred W. Harvey shop for a pair of editor's shears, and—what d'y'know—I ran into General Chemical's gift to the mid-west. We only had a minute to say hello, but I was reminded once again that the people I know in the water and sewage works profession are mighty good Joes and you can find them anywhere—and if that's corn, remember that I came from the heart of the great corn desert.—Ouch!

* * *

Just to prove that statement about good birds in this business, here's a couple I shot down Washington, D.C., way right after the

famous oyster roast at Dalecarlia Filter plant. Talking is Gus (Whitman and Requardt) Requardt and listening is Ed (Washington Supt.) Schmitt, who is Past Chairman of the Chesapeake Section.

* * *

Some of you may remember that only a couple of years ago, I was running around the country making speeches about Public Relations.—I still think a lot about P.R. and am glad to see many cases where productive efforts are being made both internally and externally. Hearing

Winston Churchill's name so frequently recently, I'm reminded that in his "Their Finest Hour" he wrote something that you superintendents and managers might like to think about in your own internal public relations.

Churchill, in explaining why he was glad to have the position of prime minister, even with all of its responsibilities, wrote, ". . . In any sphere of action there can be no comparision between the positions of number one and number two [man]. . . . The duties and problems of all persons other than number one are quite different and in many ways more difficult. It is always a misfortune when number two . . . has to initiate a dominant plan or policy. He has to consider not only the merits of the policy, but the mind of his chief; not only what to advise but what is proper, how to get it agreed, and how to get it done. . . . There are always several points of view which may be right, and many which are plausible. . . ."—And who am I to add anything to what Churchill has written—O.K.! Enough editorializing for this column.

* * *

Look Alikes—It was Harry Jordan, the AWWA Jordan, who called to my attention out at Milwaukee the fact that James A. Snow, Mgr. Water Utilities, Ashland, Wis., and John L. Snow, Dist. Engr. Layne Central, Montgomery, Ala., not only have the same name but look enough alike to be brothers. See for yourself?

"J.A."

"J.L."

* * *

It was Lou ("Transite" Pipe) Frazza who philosophized once that "if your business isn't worth advertising, then advertise it for sale."

* * *

Liberal Education—Working with W. Homer (FSWA) Wisely on some back issues of Sewage Works Journal, I was amazed to find how much information is in those old journals. 'll bet there isn't one per cent of the members of FSWA who know that it was Charles R. (Cons. Engr.)

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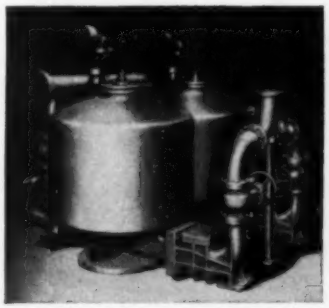
FOR EVERY MUNICIPAL INSTALLATION

SHONE® PNEUMATIC EJECTORS

• IN SEWAGE LIFT STATIONS • IN SUBWAYS • IN MUNICIPAL SEWAGE TREATMENT PLANTS



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For 75 years, in hundreds of municipal installations around the world, Shone Pneumatic Ejectors have been a symbol of utter dependability.

You may have heard the amazing story of the Shone Ejector sealed in its pit for more than 20 years—never inspected because it was not listed among mechanical equipment; rediscovered when alteration work opened the pit—operating as rhythmically and quietly as the day it was installed.

These far-sighted communities wanted the best, chose Shone Ejectors for recent installations:

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Campus, University of Washington, Seattle (2)
Chicago, Ill., West Side Subway Extension (22)
Osceola, Iowa
Mt. Clemens, Mich.
Freeport, L. I., New York (6)
Port Washington, L. I., New York (2)
Moorehead, Minn., Treatment Plant (6)
Anacostia Treatment Plant, Washington, D. C.

A few of hundreds of older Shones operating as efficiently and dependably as ever:

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Silver Springs, Fla.	Pontiac, Mich.	Enid, Okla.
Dublin, Ga.	Royal Oak, Mich.	Tulsa, Okla.
LaPorte, Ind.	Tawas City, Mich.	Providence, R. I.
Warsaw, Ind.	Faribault, Minn.	Memphis, Tenn.
Cedar Rapids, Ia.	Winona, Minn.	Austin, Tex.
Davenport, Ia.	Brookhaven, Miss.	Dallas, Tex.
Sioux City, Ia.	Butler, Mo.	Madison, Wis.
Hays, Kans.	Rolla, Mo.	Milwaukee, Wis.
Salina, Kans.	Bloomfield, Nebr.	Neenah, Wis.
Winnsboro, La.	Manchester, N. H.	Laramie, Wyo
Aberdeen, Md.	Auburn, N. Y.	
Baltimore, Md.	Olean, N. Y.	

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Shone Ejectors require **no attention.** They can be operated from distant compressors — and several can be operated from a single compressor plant.

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Write for Bulletin 4004—contains Air Volume and Pressure Table, sizes, dimensions, air piping layouts and other comprehensive specifications.

Use the coupon—for convenience.

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PUMPS FOR BUILDINGS, MUNICIPALITIES, INDUSTRIAL APPLICATIONS—
and a complete line of Sewage and Waste Treatment Equipment

Yeomans Brothers Company
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Please send your Bulletin 4004.

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Company_____
Address_____
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SARAN LINED

steel pipe

cuts repairs and replacements to a minimum!

The conveyance of corrosive liquids can prove as hard on profits as it is on equipment. It's this realization that has compelled more plants than ever before to install corrosion-resistant saran lined steel pipe. Saran's resistance to most chemicals and solvents reduces shutdowns and lost production! Saves time and labor!

Saran lined steel pipe is available in maximum lengths of 10 feet and in sizes from 1 to 6 inches inclusive. Also available are saran lined diaphragm valves, plug valves, flanges, reducing flanges, flanged fittings, gaskets and fittings with union ends.

Write us today for further information concerning saran lined steel pipe and how it may help solve your corrosion problems. Manufactured by The Dow Chemical Company, Bay City, Michigan, distributed by Saran Lined Pipe Company, Dept. TSP-23.

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SARAN LINED PIPE

DOW

product

Velzy, now of N.Y.C., who "invented" the famous tipping bucket sludge meter at Aurora, Ill.—And in doing some work with Rick Johnson (JAWWA Editor) on the MWQT, I learned that it was a man named Faber who introduced the name microscope for that instrument.—Wonder if Harry A. (Chlorine Institute) Faber is any relation?

* * *

From my "rural editor" Nelson M. Fuller, Supt. at Batavia, N.Y., came a piece of the newspaper Franc-Amerique, no. 190, Jan. 1, 1950. The checked item was captioned "Epidemie à Lyon." Nels sent this translation: "Epidemic at Lyons (France). Several cases of typhoid have been verified at Lyons. They are credited either to a contact with persons recovering from illness or to the drinking of contaminated water outside of the city. Elsewhere an epidemic of a more serious character that at Lyons continues to rage in the department of the Loire where about one hundred cases are counted to the present time."—Travelers take note!

* * *

Don't forget—Next issue is the annual Ref. & Data number!

V.T.Y.—Doc

THE SPILLWAY

[Overflow from the main section]

Jail Sentences For Mayor and Five Councilmen

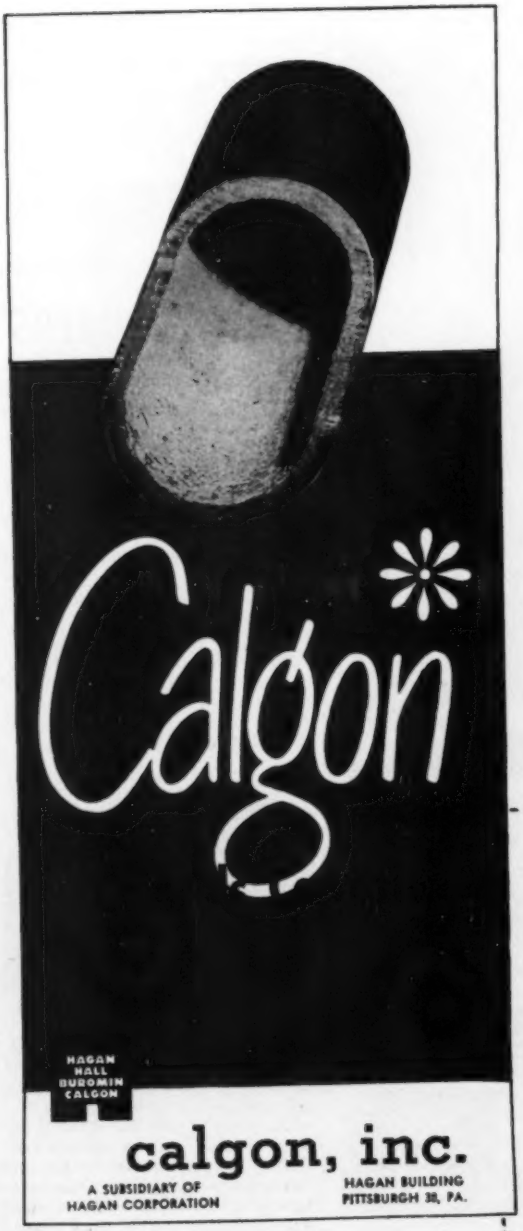
All Because of Failure to Pay Share of Costs of Sewage Treatment

The Mayor of Vernon, Calif., and five members of his Council were sentenced to serve jail terms by Superior Court Judge John Vickers.

The sentences to jail terms for these officials resulted from refusal of Vernon to pay its share of cost of constructing the Hyperion Sewage Treatment Plant, which is to serve Los Angeles, and contiguous communities connected to the Los Angeles sewer system.

Louisiana Water and Sewage Short School

The annual Short Course for water supply and sewage works personnel in Louisiana was held in the Small



Having trouble with CORROSION in your water system?...

Calgon* *controls corrosion*

This bulletin gives full details. To get your copy, just fill in and mail the coupon.

*T.M. Reg. U.S. Pat. Off.

CALGON, INC.
HAGAN BUILDING
PITTSBURGH 30, PA.

Please send me your bulletin "Calgon Controls Corrosion."

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WSW-4

Auditorium, Agricultural Building, Louisiana State University, Mar. 15, 16 and 17. This is the thirteenth successive short course sponsored by the General Extension Division and the College of Engineering in cooperation with the State Department of Health and the Louisiana Conference on Water Supply and Sewerage. A program of certification of personnel was carried on by the Conference.

Director of the program was John H. O'Neill, Director of the Division of Public Health Engineering, Louisiana Dept. of Health. Among the topics discussed were Water and Sewer Extensions, Filter Materials, Zeolites, Sewage Treatment Control, Selection and Maintenance of Pumps, Metering, Water Well Design, Bacteriology and Chemistry.

Round Table on Industrial Wastes Analysis

At the 52nd meeting of the Am. Soc. Testing Mtls., held last June, a Round Table Discussion was held on the "Need for Standards for the Examination of Water Borne Industrial Wastes." A Reprint Bulletin of ASTM explains the scope of ASTM Committee D-19 in this connection and includes two articles which were presented at that meeting. These articles are "The Need for Uniformity in Methods of Analysis and Reporting Water Borne Industrial Wastes" by George D. Beal and S. A. Braley; and "Gaging and Sampling Water-Borne Industrial Wastes" by Charles F. Hauck. Also included in the reprint is the joint discussion of the papers.

Committee D-19 has organized a Sub-committee VII for handling the work on this problem of industrial waste analysis. The Sub-committee has divided the work into four sections—A—Critical Constituents of Water-Borne Industrial Wastes; B—Analytical Methods for Industrial Wastes; C—Methods of Sampling, Gaging, and Preservation of Samples; and D—Methods of Reporting Analytical Results.

Washington, D. C. installed the equivalent of approximately 5 miles of 36" mains in various parts of its distribution system at a cost of approximately $4.00 per foot. This was in contrast to the normal cost of around $28.00 per foot required for new mains of this size. This economy was realized by cleaning and cement lining a group of 36" cast iron water mains thereby raising the W—H coefficient from an average of 80 to more than 140—an increase of 75% in carrying capacity.

The improvements in the operation of the system were immediate. The pressures available to the suction side of the high-service pumps constantly stayed above 20 p.s.i. after cleaning and lining, whereas they had formerly dropped to 15 p.s.i. This 5-pound increment alone had raised the discharge considerably. The total cost to the District for the cleaning and lining of these 36" mains in paved city streets, including field work, engineering, overhead and services, was $3.92 per linear foot.

CEMENT MORTAR LININGS FOR WATER MAINS CENTRIFUGALLY APPLIED *to strict conformity with* **A. W. W. A. Specifications.**

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET
NEW YORK 6, N. Y.

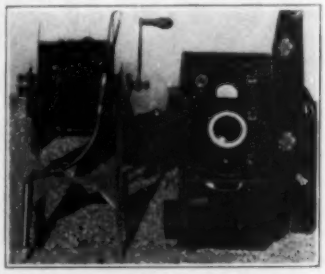
Branch Offices in all Principal Cities of the United States and Latin America.

MANUFACTURERS' and EQUIPMENT NEWS

401

Water Level Indicator

Fisher Research Laboratory, Inc., Palo Alto, Calif., has developed a new electrical instrument for measuring the depth to water in wells under both pumping and static conditions.



Known as the Fisher M-Scope Water Level Indicator, the new device operates from dry cell batteries and will determine the exact depth of water under a wide variety of conditions, whether or not casings exist. Casing leaks above the water level and the mineral content of the water have no effect on the results obtained. The electrode unit is small enough

(1¼-in. dia.) to use without the necessity for altering the position of pump units. There is no danger of an electric shock to the operator.

This unique instrument promises to be of considerable interest to operators of ground water supplies. To obtain further information on this unit, mail a Reader Service Card on which is entered the above key number and your name and address.

Jack Orr Southern Mgr. Rensselaer Valve

Rensselaer Valve Co., Troy, N.Y. has announced the appointment of Jack P. Orr as Sales Manager of its

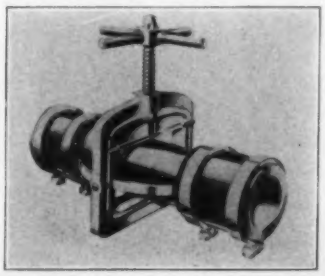
Southern Branch with headquarters at 1020 Dermon Building, Memphis, Tenn. This office will cover the Southwest, Southeast, and mid-south areas and several new salesmen will be added.

A graduate of Purdue Univ., Mr. Orr joined the company in 1928 and was later manager of the Dallas Branch until he joined the Army Engineer Corps in 1942. In 1945 he was discharged as a Captain and returned to the company to manage the Memphis office.

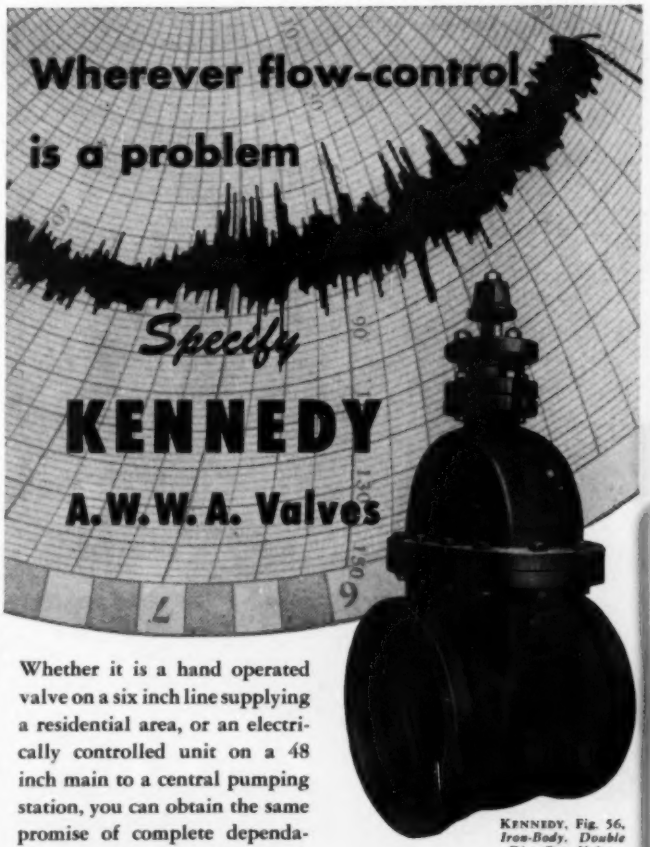
402

Pinch Type Flex-Valve

Flexible Valve Corp. Palisades Park, N.J. has developed a new type pinch type "Flex-Valve" for controlling the flow of highly abrasive or



corrosive materials. The valves may be obtained in the slip-on type in sizes of ½ to 2½-inch which mount over the end of pipe, or with flanged ends in sizes from 1 to 12 inches and



KENNEDY, Fig. 56, *Iron-Body, Double Disc Gate Valve.*

Whether it is a hand operated valve on a six inch line supplying a residential area, or an electrically controlled unit on a 48 inch main to a central pumping station, you can obtain the same promise of complete dependability and always-on-the-job performance from every KENNEDY A.W.W.A. valve you install.

Page 15 of the KENNEDY Catalog shows an illustration from the *Scientific American* of October 15, 1892, of a 48 inch KENNEDY Valve that was installed in New York City in that year. Forerunners of the present waterworks valves, many such half-century old KENNEDY valves are still in service . . . ample testimony to the rugged strength and extra service that have always been built into KENNEDY valves.

Conforming to the specifications of the American Water Works Association, KENNEDY A.W.W.A. Valves are especially designed with water works control problems in mind. They are available in all sizes from 3 inches to 60 inches . . . non-rising and outside-screw-and-yoke types . . . with a wide variety of gearing arrangements, controls and accessory equipment available.

Write for complete information

THE KENNEDY VALVE MFG. CO.
1036 EAST WATER ST.
ELMIRA, NEW YORK
VALVES · PIPE FITTINGS · FIRE HYDRANTS
OFFICE-WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

in a diaphragm motor type from 1 to 10 inches.

The "Flex-Valve" offers such features as no internal parts or obstructions, freedom from water hammer, long life under abrasive wear, full pipe capacity, bubble tightness and simple installation. These valves should find use in the handling of chemicals and sludges in water and sewage treatment plants.

For further information, use a Reader Service Card on which is entered the above key number and your name and address.

Builders Iron Fdry. Service Awards

Pres. Chafee Receives 40 Year Pin

Builders Iron Foundry, Providence, R.I., parent company of Builders-Providence, Inc., %Proportioneers%, and Omega Machine Co., held its sixth annual service award dinner on Feb. 11. These awards are made to employees who have been associated with the company for 5, 10, 25, and 40 years. This year there were 65 persons so honored, with five persons receiving 25-year pins, and three receiving 40-year awards.

Included in the 40-year group was Henry S. Chafee, President of the company who received his award from Chairman of the Board, Zachariah

Photo by Providence Journal

Two 40-Year Men Receive Awards

(Raymond Januszewski and President H. S. Chafee are congratulated by Board Chairman Zechariah Chafee, Jr.)

Chafee, Prof. of Law at Harvard University. Sixty-three persons have now completed 25 years or more service with the company.

The dinner was presided over by R. J. Leveque, Sales Mgr. of Omega Machine Co., who acted as Master-of-Ceremonies. Featured on the program were the initial appearance of the 44 member glee club of the company and a talk by Charles G. Richardson, Vice Pres. of Builders-Providence, who spoke on "Humor Patented," an illustrated presentation on various humorous and ridiculous devices that have been patented by inventors in the past.

THE SUN NEVER SETS ON

% PROPORTIONEERS % Little Red Pump

%Proportioneers% Heavy Duty Midget Chem-O-Feeder — "The Little Red Pump" — is known and trusted in every corner of the world. To the Chinaman, African, and American alike it means safe, pure water. It handles the all-important jobs of water sterilization, taste and odor control, water softening, and dozens of other water treating applications. Because of its extremely simple, rugged construction, the Little Red Pump can be safely operated by almost anyone. It treats from a few gallons to a million gallons of water a day and feeds chemicals up to 7½ g.p.h. against pressures to 85 p.s.i. The chemical being fed shows plainly in the "See-Thru" plastic head and the action of the valves and diaphragm is clearly visible. Over 27,000 %Proportioneers% units right now are making this a healthier, better world to live in.

Write for Bulletin HDM-2

FEEDS . . .
Hypochlorite Solution
Hexametaphosphate
Alum Solution
Ferric Chloride
Soda Ash
Sodium Fluoride
and other water treating chemicals

% PROPORTIONEERS, INC. %

350 HARRIS AVENUE, PROVIDENCE 1, R. I.

403

Bell Joint Clamp

M. B. Skinner Co., South Bend, Ind., offers the Skinner-Seal Bell

Joint Clamp for stopping bell and spigot leaks under pressure. The gasket in one of these bell joint clamps is completely sealed at the bell face by

(Continued on page 91A)

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WATER & SEWAGE WORKS READER SERVICE

READER SERVICE CARDS HOW TO USE THEM

Please fill out a separate coupon for each item on which you desire information. This will greatly facilitate handling.

Key number is at head of each new product, item of equipment, catalog or bulletin, described in this issue.

Enter key number in box.

Please PRINT your name and title, company or department name, and your address

NOTE—

These cards are to be used only for items described in THIS ISSUE

WATER & SEWAGE WORKS

Will see that you receive information desired.

(Continued from page 90A)

a Monel metal seal band, soft enough to conform to the irregularities in the face of the bell and at the spigot by a hard vulcanized gasket tip acting as a plug.

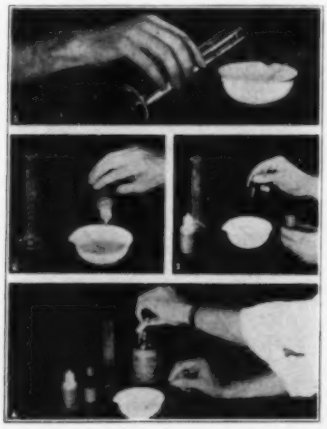
The compression ring adjusts automatically to all normal variations in pipe size, and the Monel metal seal band seals the gasket. A locking device on this band eliminates the use of tongs, and with a ratched take-up, holds joint and gasket together while clamp is being applied. Clamps are made of malleable iron. A full stock of special clamps is available for use where steel mains are leaded into cast iron bells and other unusual conditions.

For further information on these bell joint clamps, mail a Reader Service Card on which is entered the above key number and your name and address.

404

Hagan Total Hardness Test

Hall Laboratories, Inc., Pittsburgh, Penna., has announced a new total hardness test, based on the discoveries of Dr. Gerold Schwarzenbach, with Hall modifications that makes the test convenient for field use.



The new Hagan Total Hardness Test, as it is designated, is superior to the time consuming soap hardness test. The new method involves a simple direct titration with a distinct color change at the end point. The possibility of error due to subject judgement is eliminated.

The accompanying photograph shows the simple method. To obtain further information, use a Reader Service Card on which is entered the above key number and your name and address.

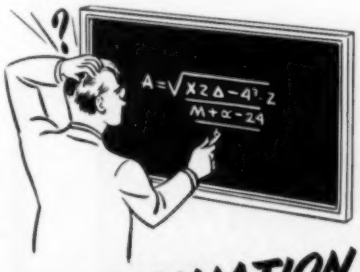
Jeffrey Twenty Year Service Club

The Jeffrey Manufacturing Co., Columbus, Ohio, believes in good public relations with its employees and each year holds a dinner party for all those who have reached the 20-year mark or longer with the company. This year the "party," complete with entertainment, was held for 27 men and one woman who had become eligible for membership in the club. An attractive booklet distributed at the banquet listed all the members of the club and the number of years each has worked. Ten men still working have been with the company for fifty years, and five reached that goal this past year.

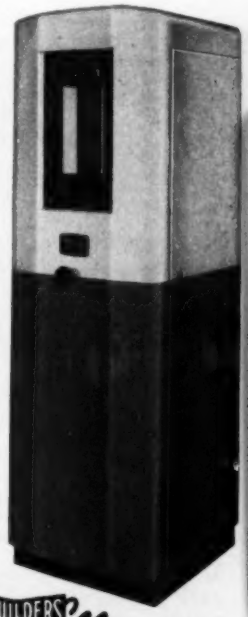
405

Parlon Protective Paint

Hercules Powder Co., Wilmington, Del., has developed a chlorinated rubber base paint. Known as "Parlon" paints, the outstanding property is their practical complete immunity to attract by almost all agents which destroy conventional paints.



CHLORINATION WITHOUT COMPLICATION



Chlorination can be simple, and Builders Chlorinizers will prove it to you. Here, at last, are chlorine gas feeders that give the same good service winter or summer, that require minimum attention and maintenance, and that simplify plant operation instead of complicating it. It's easy to get accurate chlorination with Builders Chlorinizers — your regular plant personnel is fully capable of operating these reliable feeders.

Simplicity means safety, too. The powerful, spring-loaded chlorine control valve delivers the exact amount of chlorine required — yet is ready to stop the flow instantly, if any condition occurs to interfere with safe operation. It will pay you to learn more about these and the many other advantages of Builders Chlorinizers: for manual, semi-automatic, program, or flow-proportional chlorination. For Bulletins and engineering information, address Builders - Providence, Inc. (Division of Builders Iron Foundry), Providence 1, R. I.

BUILDERS Chlorinizers

The chlorine gas feeders with extra features

BUILDERS PRODUCTS

The Venturi Meter • Propelaflo and Orifice Meters • Kennison Nozzles Venturi Filter Controllers and Gauges Conveyaflo Meters • Type M and Flo-Watch Instruments • Wheeler Filter Bottoms • Master Controllers • Chlorinizers — Chlorine Gas Feeders • Filter Operating Tables • Manometers Chronaflo Telemeters

350

BUILDERS PROVIDENCE Instruments

These paints are ideal for use as protective coatings in water and sewage plants. They are particularly useful for metal surfaces as well as concrete. They are not affected by alkalies and most acids and they have an outstanding wear resistance. These "Parlon" paints dry rapidly, and may be obtained in many colors. They can be washed with soap and water, and because of their long life reduce maintenance costs.

For further information about these remarkable paints, use a Reader Service Card on which is entered the above key number and your name and address.

406

Magna-Sight Flow Gage

Fischer & Porter Co., Hatboro, Penna., has completely redesigned the Magna-Sight flow gage. The unit consists of a short body, with flanged or screwed pipe connections, which accommodates a fixed orifice in the lower end. A tapered metering plug rises and falls with fluid flow rate in accordance with variable-area metering principles.

The metering plug carries a permanent magnet and a hollow, cylindrical soft-iron follower rides in an external slot. The position of the follower relative to a calibrated external scale plate indicates the flow rate.

The Magna-Sight is available in brass, bronze, iron, steel and stainless steel and in sizes from ¾ to 4-in. and with capacities from 3.5 to 250 gpm.

Further information on this flow gage may be obtained if you will mail a Reader Service Card on which is entered the above key number and your name and address.

Puromat Represents Carter in Ill., Iowa, Wis.

Announcement has been made of the appointment of the Puromat Co. of Chicago as representatives of the Ralph B. Carter Co. of Hackensack, for the complete line of Carter equipment.

President of Puromat Co., Frank D. Prager has been in the field since 1935 and organized the company in 1948. He had formerly been associated with Infilco and Graver Tank and Mfg. Co.

Puromat Co. located at 30 No. LaSalle St., Chicago will represent Carter in the states of Illinois, Iowa, and Wisconsin.

407

Precision Hydraulic Relief Valve

Pantex Mfg. Co., Pawtucket, R.I., has developed and released a new cartridge type of hydraulic relief valve. This valve which has been certified by the Navy is available for pressure range settings of 100 to 5000 psi. The new valve opens and closes within a 7 per cent differential, is silent and free from squeal or chatter. It shows no more than a 5 per cent

WARREN
Solves Your
PIPE
PROBLEMS
BELL & SPIGOT PIPE •
FLANGE PIPE •
MECHANICAL JOINT PIPE •
FLEXIBLE JOINT PIPE •
SPECIAL CASTINGS •
SHORT BODY BELL & SPIGOT SPECIALS •
Warren Cast Iron Pipe and Fittings can be supplied in all sizes 2" to 84" with all types of joints and in accordance with Standard Specification. Specify "Warren Pipe" for your next job.
Take advantage of our large stock of non-standard patterns, when in need of special castings to meet your individual requirements.
Warren
FOUNDRY & PIPE CORP.
55 LIBERTY ST. — N. Y. C.
WARREN PIPE CO. of MASS. INC.
75 FEDERAL ST., Boston, Mass.

HUB ENDS . . . FLANGED ENDS . . . UNIVERSAL OR STANDARDIZED MECHANICAL JOINT

Water & Sewerage Works Materials, Catalog 34.

Fire Protection Materials, Catalog 40

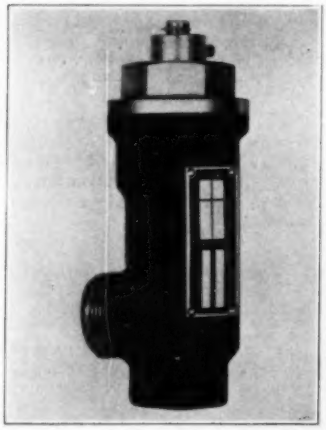
VALVES—A.W.W.A. approved, iron body, bronze mounted with double disc parallel seat or solid wedge. Non-rising stem, outside screw and yoke . . . spur or bevelled gear . . . hydraulic or motor operated . . . square bottom and low pressure. Also approved Underwriters and A.F.M. series. Shown above is an M & H 30-inch I.B.B.M. Gate Valve with bevel gears, extended grease case and 4-inch by-pass.

M & H PRODUCTS INCLUDE

- FIRE HYDRANTS
- GATE VALVES
- WALL CASTINGS
- SPECIAL CASTINGS
- TAPPING SLEEVES AND VALVES
- CHECK VALVES
- FLOOR STANDS
- SPRING LEVER CHECK VALVES
- EXTENSION STEMS
- ELECTRIC MOTOR OPERATED VALVES
- SHEAR GATES
- MUD VALVES
- FLAP VALVES
- SLUDGE SHOES
- FLANGE AND FLARE FITTINGS
- FLANGED FITTINGS
- S & S FITTINGS
- CUTTING-IN TEES
- HYDRAULIC OPERATED VALVES

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

change in operating characteristics in temperature ranges from —65 to 160° F. The entire operating mechanism is contained in a cartridge de-



signed so that it may be easily replaced without breaking the line.

To obtain further information on this new relief valve, use a Reader Service Card on which is entered the above key number and your name and address.

F. E. Lewin Exec. V.P. & Gen. Mgr. R. B. Carter

Announcement has been made of the appointment of Fred E. Lewin as

Exec. Vice President and Gen. Mgr. of the R. B. Carter Co. of Hackensack, N.J., to succeed the late J. W. (Jake) Van Atta. Mr. Lewin, who has been with the company for nearly 15 years was sales manager for the pump division and more recently vice president in charge of all sales. Well known in the construction and sanitation fields, Mr. Lewin will devote his time to sales and operational management of the R. B. Carter Co.

Homelite Creates Four New Territories

Homelite Corp., Port Chester, N.Y. has announced the creation of four new territories in the southeast section of the country, to handle sales

BOND-O *Homogenized*

Self-Caulking COMPOUND

MACHINE BLENDED

the finest jointing compound available

BOND-O is homogenized. Every pound—every spoonful—is exactly the same as every other pound. This means that with every bag of Bond-O you get consistently excellent results . . . you get the best.

BOND-O Self-Caulking Compound is the only jointing compound available today that gives you unexcelled uniformity of performance. It is the only jointing compound that can guarantee you uniform results from every bag of Bond-O you buy.

● Not one case of Bond-O jointing failure has ever been reported! For what other jointing compound can such claims be made?

BOND-O

NORTHROP & COMPANY, Inc.
SPRING VALLEY, NEW YORK

and service of Homelite gasoline-engine-driven pumps, generators, blowers and chain saws.

"Bill" Bedford will manage the Memphis territory and cover most of Tennessee and Mississippi plus some parts of Arkansas and Alabama. "Ty" Lubby will manage the Charlotte territory including North Carolina, South Carolina and twenty-four counties for eastern Tennessee. "Jim" Anderton will manage the New Orleans territory which embraces Louisana, south Arkansas and twenty-four counties in Southern Mississippi, parts of Alabama and Florida. Norman Supove will manage the Jacksonville territory covering Georgia, Florida and central Alabama.

A. C. Bromschwig Dies

A. C. Bromschwig, Chicago Representative of the Hersey Manufacturing Co., died suddenly on Feb. 25. Mr. Bromschwig associated himself with the Hersey Mfg. Co. in 1926 and has been with the company continuously since. Attached to the Chicago office, he was well known throughout the midwest and the sections of the AWWA in the territory he covered.

EASE OF MAINTENANCE
Simple, sound construction assures long, troublefree service. Only the operating thread requires lubrication —once a year should be enough.
MATHEWS HYDRANTS

Mathews Modernized Hydrants Set the Pace: All working parts contained in replaceable barrel • Stuffing box cast integral with nozzle section • Head can be turned 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for extra strength, toughness, elasticity • A modern barrel makes an old *Mathews* as good as new.

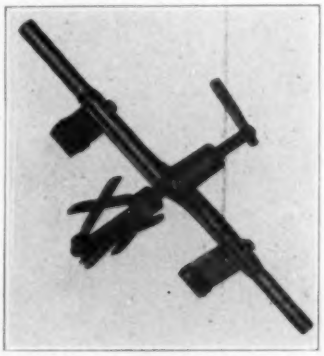
THE FIREMAN'S FRIEND

Made by R. D. Wood Company
Public Ledger Building, Independence Square
Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

408

Machining Tool For Asbestos-Cement Pipe

Pilot Manufacturing Co., San Francisco, Calif. has developed a specially engineered Machining Tool which makes it possible to machine asbestos-



cement pipe in the field or in the shop. Machining is done with the precision of a factory job on all pipe classes through 8-in. nominal (10-in. O.D.).

The Pilot Machining Tool is supplied with a turning handle, 8-in. internal expanding chuck with arbor, and two blade holders with blades. Weighing only 17 lb., the machining tool produces fast easy cutting in the field.

To obtain further information on this new unit, use a Reader Service Card on which is entered the above key number and your name and address.

S. A. Norris Asst. Sales Mgr. Yeomans Bros.

Spaulding A. Norris has been appointed assistant sales manager of the Pump Division of Yeomans Bros. Co., Chicago. Mr. Norris was previously associated with William A. DeLee, Inc., Yeomans representative in Detroit.

409

Betz Total Hardness Titration Set

W. H. & L. D. Betz, Philadelphia, Penna., have developed and are offering a new complete hardness titration test set. Based on a new technique, total hardness may be determined by a simple and accurate titration using a single color indicator. More accurate and more rapid than the soap test, the method can determine hardness to within 2 ppm. and up to more than 1000 ppm. Using a special laboratory technique, hard-

ness can be determined to 0.1 ppm. on waters of less than 5 ppm. hardness. The test set, including indicator,

buffer reagent, and titrating solution, may be obtained as a unit. A complete technical discussion of the test may also be obtained.

If you desire further information on this new test and the test set, enter your name and address and the above key number on a Reader Service Card and mail to our Reader Service Dept.

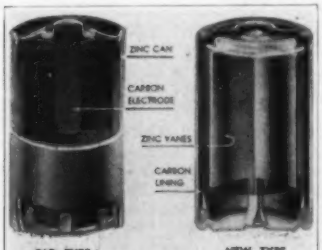
DeLaval New Branch Office Managers

DeLaval Steam Turbine Co., Trenton, N.J. has announced the appointment of two new branch office managers. John Horth has been named manager of the St. Louis office which will operate as a direct factory branch. H. H. Reynolds has been appointed manager of the Los Angeles office. He was formerly in the home office.

410

New Industrial Flashlight Battery

National Carbon Div., Union Carbide and Carbon Corp., has announced a radical departure in the construc-



tion of a new "Eveready" flashlight battery. This new battery is made "inside out"; the container, formerly made of zinc is now made of carbon with a zinc power vane as the center element, as shown in the cut-away view.

The new cell has no metal case to leak or corrode; it will not swell, stick or jam in the flashlight, and the new battery will give more light-minutes than previous cells, providing more than double the usable light. The new battery is completely interchangeable with all D-size (standard flashlight size) batteries.

To obtain further information on this new cell, use a Reader Service Card on which is entered the above key number and your name and address.

Builders % Proportioneers % Omega Mach. Co. Move Offices

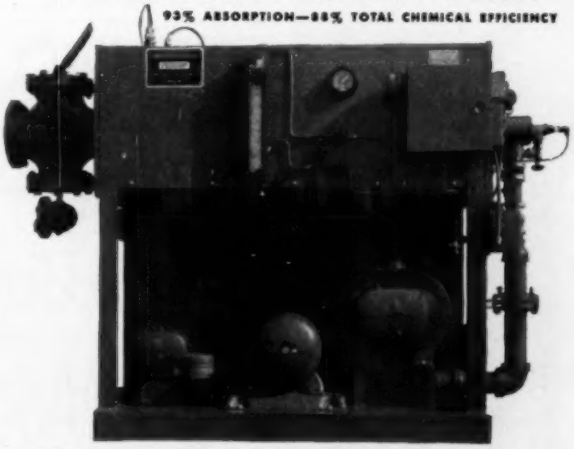
Announcement has been made by Builders Iron Foundry and its subsidiary companies, Builders-Providence, Inc., %Proportioneers, Inc.%, and Omega Machine Co. have moved their offices on Mar. 10 from 9 Codding St. to 345 Harris Ave., Providence 1, R.I.

The parent company is celebrating its 130th year at the Codding St. location where the foundry was estab-

CARBALL CO TWO UNIT...

SPECIFICALLY DESIGNED FOR THE CLEAN, EFFICIENT CARBONIZATION OF LIQUIDS

93% ABSORPTION—88% TOTAL CHEMICAL EFFICIENCY



- A CO_2 producer that COMPLETELY burns GAS or OIL.
- Produces the highest percentage of CO_2 gas with no CO or condensible carbon.
- Completely eliminates oil scum . . . no taste imparted to potable waters.
- No scrubbers or filters required.
- Compressor handles clean, cold air only. The fuel is burned under sufficient pressure to cause deep diffusion directly from the producer.
- Diffuses CO_2 gas by efficient impingement diffuser, insuring 93% absorption and eliminating diffuser corrosion.
- A factory-tested, package unit with air compressor, fuel pumps and appurtenances mounted on one frame.
- 50% more chemical efficiency than any other method in current practice.

To Reduce Costs and Modernize Your Plant:

WRITE FOR BULLETIN 757

WALKER PROCESS EQUIPMENT INC.

FACTORY • ENGINEERING OFFICES • LABORATORIES

518 HANKES AVENUE • AURORA, ILLINOIS

PROQUIP

lished in 1820 and will continue to be located. The new offices, which will house the administrative, engineering and sales and service staffs of all of the companies, is located immediately adajcent to the sheet metal and machine shops.

In announcing this move, Builders Iron Foundry points to it as another milestone in its history which include the invention of the venturi tube by Clemens Herschel in 1887, the first venturi meter register in 1901, the first venturi filter effluent controller in 1907, association with %Proportioneers% in 1933 and affiliation with Omega Machine Co. in 1944.

411

Bituminous Protective Coatings

Ralph V. Rulon, Inc., Philadelphia, Penna. developed Rulon Bituminous Protective Coatings a number of years ago. These protective coatings have been used and found exceptional for standpipes, pipe lines, steel tanks, and water and sewer pipe lines. These coatings are applied hot for attaining a thick surface coating that adheres strongly to the metal surface. Rulon Bituminous Primer and Bituminous Enamel are made of coal tar pitch and conform to AWWA specifications.

To obtain additional information about these coatings, mail a Reader Service Card on which is entered the above key number and your name and address.

Grand Coulee Dam Has World's Largest Pumps

Designed by Byron-Jackson Co. of Los Angeles and the Pelton Water Wheel Co. of San Francisco, the largest pumps ever built are being installed

at Grand Coulee Dam. These immense pumps will lift water from the Columbia River into a channel used by the river some 300,000 years ago.

The first installation will include six pumps. When six additional pumps are installed, they will furnish water for irrigating approximately 1,000,000 acres between Grand Coulee Reservoir and Hanford, Wash.

These pumps with suction elbows 14 ft. in diameter (see photograph) will each handle 720,000 gpm. and require 65,000 hp. to lift the water 300 ft. above the intake. The twelve pumps will lift more water than flows over the American side of Niagara Falls and to a height more than twice that of the American Falls.

Hooker Announces Management Changes

Hooker Electrochemical Co. of Niagara Falls, N.Y. has announced several major changes in positions of executives. Hiram B. Young, formerly Supt. of the Niag. Falls plant, was made Works Manager. Frank W. Dennis, formerly Personnel Director became Director of Industrial Relations. Leonard F. Bryant, formerly Asst. Prod. Supt. is now Plant Superintendent. Walter B. Scott, formerly Asst. Tech. Supt. is now Technical Superintendent.

SPARLING MAIN-LINE METERS

for

EFFICIENCY

in

Operation

Accurate records of main-line flows are vital to efficient operation. The Sparling Indicator-Totalizer-Recorder shown here, operated by electric remote control from a Sparling Compound Meter, is accurate within 2 per cent on flows from 3% to 100% of pipe capacity! Head loss is practically negligible.

For range of styles and sizes of water meters, instruments and controls, see Bulletin 310—sent at your request!

The SPARLING Manufacturer of WATER MEASURING EQUIPMENT

LOS ANGELES 54.....Box 3277
CHICAGO 8.....1500 South Western Ave.
BOSTON 8.....6 Beacon Street
626 Broadway.....CINCINNATI 2
101 Park Avenue.....NEW YORK 17
1932 First Avenue.....SEATTLE 1
DALLAS 1.....726 Reserve Loan Life Bldg.

LITERATURE AND CATALOGS

412
CHLORINE HANDBOOK

Diamond Alkali Co., Cleveland, Ohio, has just issued a new **Chlorine Handbook.** Containing forty-four pages, this new bulletin is replete with information, charts, diagrams, and photographs about chlorine, its production, shipment, and handling.

Beginning with the history and growth of the chlorine industry, the bulletin takes the reader through chlorine characteristics, chlorine containers, handling equipment, vaporizers, first aid measures, gas masks, and emergencies. This makes up the general information section of the book.

The second section of the bulletin is devoted to technical data including physical properties of chlorine, properties of saturated chlorine, vapor pressure, density, enthalpy, specific volume of chlorine, solubility, and viscosity.

This is a bulletin that every water or sewage plant using chlorine and every engineer should have. To obtain a copy, fill in a Reader Service Card with the above key number and your name and address and mail it to this magazine.

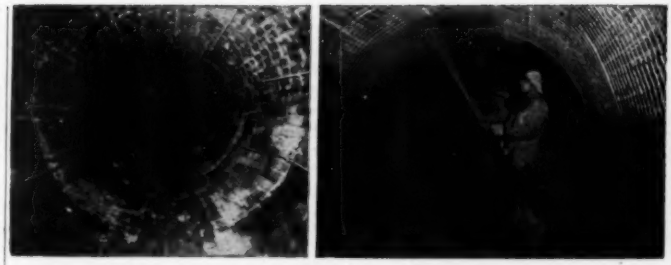
413
WATER SOFTENER

Worthington Pump & Machinery Corp., has published a bulletin on **A Cold Process Slurry Type Precipitating Water Softener and Coagulator.** This bulletin describes how the unit works and shows the cutaway drawing of its several mechanical features, describes each feature, shows pictures of the equipment, tells how it operates and compares the old process with the new slurry type water softener system. The bulletin is more than a catalog of an equipment item; it contains some very interesting information on the subject of water softening.

To obtain a copy of the bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

414
"TRANSITE" PIPE INSTALLATION GUIDE

Johns-Manville, New York, N.Y., has prepared and released a new publication titled, **Installation Guide—"Transite" Pressure Pipe.** It was



"GUNITE" STRENGTHENS EXISTING SEWERS

Reinforced "GUNITE" lining has been successfully used on brick, tile and concrete sewers, restoring them to greater than originally designed strength.

Erosion of mortar joints and dislodged bricks made many sections of the above 65-year-old brick sewer in Illinois both dangerous and inefficient. We placed a reinforced "GUNITE" lining of varying thickness in this sewer without opening the streets. Sewer service was maintained by installing temporary flumes and also by by-passing through relief sewers.

This job, and many other types of "GUNITE" jobs which we have done, are illustrated and described in our new 64-page general bulletin C2400. A request on your letterhead will bring you a free copy by return mail.

We will be pleased to cooperate with you on any of your problems.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

ROTO-TROL
940
Write for Bulletin

THE 940 Roto-Trol will control your pumps, valves, alarm circuits, etc., all from one float. Each circuit is completely independent from all others, and may have several starting and stopping positions on both a rising and falling level. Can be set on the job. No special tools or experience required. All circuits, from two to ten or more, are made through snap action of mercury switches.

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HEALY-RUFF COMPANY
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RELEASE EXCESS AIR
PREVENT AIR LOCKS
PROTECT PIPE LINES
WITH
APCO AIR RELEASE VALVES

ONE OF OUR

17 TYPES

NO. 200 AIR RELEASE VALVE
AIR AND VACUUM VALVES
PUMP PRIMERS
TANK AND VACUUM TYPES

VALVE & PRIMER CORPORATION
127 N. DEARBORN ST.
CHICAGO 2, ILL.

prepared especially for men who direct and do the actual work of handling and installing this pipe.

Of convenient pocket size, 4½ x 8 inches, its 115 pages are divided into fifteen sections. These sections cover the whole job of installation from receiving and handling the pipe to pressure and leakage tests of the finished line.

More than a hundred line drawings illustrate important operations, and the guide is arranged so that problems are taken up in the order in which they occur on the job.

To obtain a copy of this helpful guide, write your name and address and the above key number on a Reader Service Card and mail it to this magazine.

415

LIQUID LEVEL RECORDING

Leupold & Stevens Instruments Co., Inc., Portland, Ore., has just issued an engineers' file folder with complete data on **Liquid Level Recording Instruments.** The file contains complete information on the many types of instruments that measure liquid levels in water and sewage plants, as well as irrigation and industry.

The file folder also contains a discussion of the various problems covered by instruments designed to do a specific job. This file folder will be of particular interest to engineers who are working on problems of liquid measuring instruments.

To obtain a copy of this useful file folder, mail a Reader Service Card on which is entered the above key number and your name and address.

416

pH AND CHLORINE CONTROL

W. A. Taylor and Co., Baltimore, Md., has issued a revised edition of their handbook entitled, **Modern pH and Chlorine Control.**

The new booklet describes the complete line of Taylor Comparators for the determination of pH, Chlorine, and Phosphate, as well as the new Sulfite Comparator, and the new sets for the determination of calcium and magnesium, aluminum, and total hardness. New sets are also available for chromium, quaternary ammonium compounds, and high total iron.

The booklet includes a discussion of the various methods of pH and chlorine control and shows pictures and gives instructions for the use of Taylor Comparators.

To obtain a copy of this booklet, use a Reader Service Card on which is entered the above key number and your name and address.

417

CHEMICAL FEEDER

Milton Roy Co., Philadelphia, Pa., has issued a bulletin on the **Milton Roy Constametric Pump.** This is the controlled volume pump that delivers in straight line flow without pulsation. The 4-page folder describes the application of this versatile unit, gives capacities, pressures and engineering data. Two units are shown.

For a copy of this bulletin or further details, use a Reader Service Card on which is entered the above key number and your name and address.

418

PARSHALL FLUME AND WEIR CONTROLLER

The Foxboro Co., Foxboro, Mass., has issued another in its series of Application Engineering Data. This one on the **Parshall Flume and Weir Flow Recorder Controller.** This eight page bulletin, punched for a ring binder, presents a general discussion of the recorder controller, and shows dimension data and diagrams for the constructing of V-Notch, Rectangular and Cippoletti Weirs, and Parshall Flumes. Data

36 WORDS ABOUT SEWAGE TREATMENT 36

The Bio-Chemical Process (a Guggenheim development) is a proved, economical, complete treatment of sewage—lowest first cost—lowest operating costs, utilizing community trade wastes to treat sewage.

Investigate this process without cost or obligation.

(If you counted only 36 words, you probably didn't realize that "economical" and "proved" are doubly important in connection with the Bio-Chemical Process)

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MOTOR TRUCK MOUNTING
FOR GATES TO 60 IN.
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GATES UP TO 48 IN.
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FOR SMALL GATES IT'S THE POWERENCH
GAS ENGINE DRIVE
PORTABLE, WEIGHS 37 LBS.
PAYNE DEAN & CO. MADISON, CONN.

A DEPENDABLE JOINTING COMPOUND

FOR BELL AND SPIGOT WATER MAINS

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TURBIDIMETER
A TURBIDIMETER WITHOUT STANDARDS
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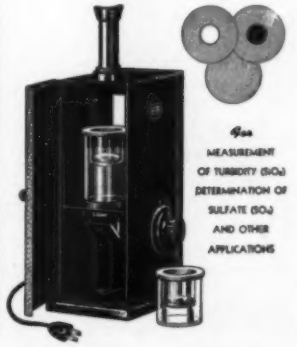

WRITE FOR CATALOG No. 8000
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INCORPORATED
3310 NORTHERN BLVD. LONG ISLAND CITY 1, N.Y.

LEADITE
The Pioneer Self Caulking Material for C.I. Pipe
4 REASONS
why more miles of cast iron water mains are jointed with LEADITE than with any other melted self-caulking material:
- MELTS EASILY
- GOES FARTHER
- SAVES TIME, LABOR, COST OF MATERIAL
- MAKES A GOOD TIGHT JOINT THAT IMPROVES WITH AGE!

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia 2, Pa.
No Caulking

are also given on instrument specifications.

To obtain a copy of this informative bulletin, mail a Reader Service on which is entered the above key number and your name and address.

419
OIL SEPARATOR

Hardinge Co., Inc., York, Penna., has issued a reprint of an article by G. E. King on an **"Oil Separator for Waste Water Disposal."** Mr. King, of the Technical Service Div. of Standard Oil Co. of Ohio published the original article in *Petroleum Refiner*. The article describes the oil separation facilities at the Toledo plants of the Pure Oil Co. and the Std. Oil Co. of Ohio. Complete diagrams, photographs, and descriptions as well as operating data are given. The equipment used was that of the Hardinge Co.

To obtain a copy of this informative article, use a Reader Service Card on which is entered not only the above key number but also your name and address.

420
ROTARY BLOWERS

Roots-Connersville Blower Corp., Connersville, Ind., has just issued a bulletin covering its **Type XA Gas Pumps.** These units which are built in 18 standard sizes with capacities ranging from 5 to 620 cfm. at pressures up to 2 psi., from 5 to 320 cfm. up to 4 psi., and from 5 to 175 cfm. up to 6 psi.

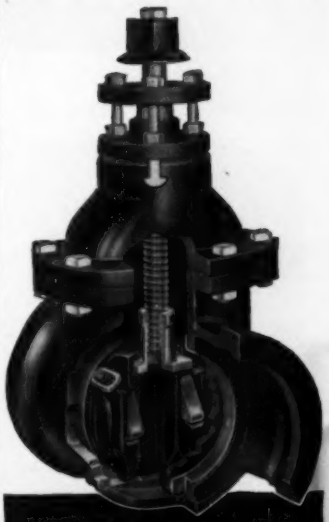
The 8-page booklet discusses the advantages of the rotary-positive principle. Sectional views of the blowers are included along with a chart to graphically illustrate volume and power characteristics of the various types of drives, etc.

Where diffused air aeration is used, these pumps have a use, and this bulletin will be of interest to prospective users. To obtain a copy of the bulletin, mail a Reader Service Card on which is entered the above key number and your name and address.

421
TRI-CLAD MOTORS

General Electric Co., Schnectady, N.Y., has issued a bulletin on its **Tri-Clad High Speed Synchronous Motors.** This 8-page bulletin lists some of the applications for these motors including the driving of pumps. The bulletin shows typical installations and describes construction features and mechanical modifications.

To obtain a copy, write your name and address and the above key number on a Reader Service Card and mail.

IOWA valves

Simple . . .
rugged construction
MEET ENGINEERS RIGID 3 POINT SPECIFICATIONS

1 Solid bronze Wedges
are placed loosely in two iron hooks which permit the wedging surfaces of the wedges to be at different angles with the wedges cast on the valve discs. *Solid bronze stem nut* is loose and independent of the gates and wedges, thus preventing binding or springing of the spindle or freezing of the gates.

2 All Working Parts
are bronze or *bronze mounted* to safeguard against corrosion as well as to permit free and positive operation both in wedging the gates into contact with the seats and in releasing them.

3 Iowa Valves
exceed A.W.W.A specifications and meet engineers choice for a quality product.

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201-299 N. Talman Avenue • Chicago 80, Illinois
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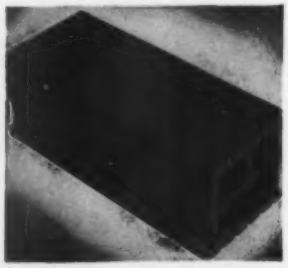
Leopold

GLAZED FIRE CLAY TILE FILTER BOTTOM



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Complete water purification and sewage plant equipment.

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F. B. LEOPOLD CO., INC.
2413 W. CARSON ST. PITTSBURGH 4, PA.

To obtain a copy of this bulletin, mail a Reader Service Card on which is entered the above key number and your name and address.

423
WATER & SEWAGE WORKS EQUIPMENT

Infilco, Inc., Chicago, Ill., has available a four page folder on **Equipment for Municipal Water and Sewage Plants.** This is a handy bulletin to show at a glance the types of equipment manufactured by the company for use in these applications. More than twenty different types of equipment are shown and described briefly.

To obtain a copy of this bulletin, just mail a Reader Service Card on which you have entered the above key number and your name and address.

424
SLUDGE COLLECTORS

Chain Belt Co., Milwaukee, Wis., has a bulletin on **Rex Conveyor Sludge Collectors.** This 20-page bulletin presents nine features of the Rex Sludge Collectors; for the small plant a diagram of the Type MI collector is shown, and photographs and lists of typical installations are given. A double page spread shows the Rex Roto-skim for quick thorough scum removal, and another two page spread gives the diagram, data, and photograph of the Verti-Flo Clarifier. Appurtenances are also shown.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered your name and address and the above key number.

425
CONTROL WATER SEEPAGE

Prufcoat Laboratories, Inc., Cambridge, Mass., has issued a 4-page bulletin on **Pruftite for Controlling Water Seepage and Dampness.** Pruftite is used above and below grade, interior or exterior on brick, concrete, cement plaster, stucco and concrete masonry units. The bulletin shows by illustrations how Pruftite treated specimens of concrete have no permeability to water under 155 psi. According to the bulletin, three types of Pruftite are available, one for porous masonry surfaces, a second for dense masonry surfaces, and a third for color protection of masonry surfaces exposed to sunlight. A series of questions and answers about Pruftite are presented.

To learn more about this new material, send for this bulletin. Just

M-SCOPE Pipe Finder
LIGHTWEIGHT MODEL

Catalog No. 25M On Request

JOSEPH G. POLLARD CO., INC.
Pipe Line Equipment
New Hyde Park New York

422
RATO-CHLOR CHLORINE DISPENSER

Fischer & Porter Co., Hatboro, Penna., has issued an 8-page illustrated catalog describing the **Rato-Chlor Chlorine Dispensers.** The catalog includes accessories, applications, capacity, design features as well as a discussion of systems of direct proportion, gas injection, and high-capacity. Also included in the bulletin is a section on operation and recorders controllers, totalizers, and proportioners for use in connection with chlorine dispensing.

To improve floc formation

N-SOL PROCESSES FOR WATER COAGULATION

use "N" Sodium Silicate to produce
ACTIVATED SILICA SOL.

A reactant such as ammonium sulphate, chlorine or sodium bicarbonate with "N" Silicate yields N-Sol (activated silica sol).

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CARSON CLAMPS
With Pearlitic C.I. Bolts for Cast Iron Pipe and Fittings.
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CONTROL
Gas Pressures

From Digestion Tanks with NORWALK REGULATORS and CHECK VALVES

Handling sewage gas from digestion tanks is one of Norwalk Valve's activities in the manufacture of gas pressure control equipment. Stock items include check valves, pressure relief valves, regulators, all sizes and pressures. Illustrated are the Norwalk Disc Check Valve and the "Meter Cop" (a Norwalk exclusive).

DESIGN AND FABRICATION OF SPECIAL UNITS

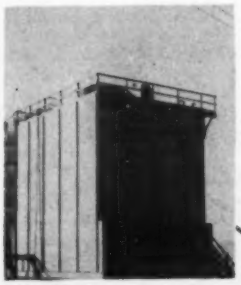
Any unusual problems can be solved by our design and fabrication of special units. Norwalk products are made with ASTM and other materials required by contract specifications.

Outline your requirements in a note to us. We'll be glad to suggest designs and special equipment. We'll also send along a catalogue of our complete line of gas control equipment.

NORWALK VALVE COMPANY

33 RAILROAD AVENUE SOUTH NORWALK, CONN.

"Our best ads are installed . . ."



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426

GATES AND VALVES

Mueller Co., Chattanooga, Tenn., has a catalog on the **Mueller Columbian Line** for Sewage Disposal Plants, Water Plants, Pumping Stations, and Power Projects. This 48-page catalog contains specifications, diagrams, photographs and descriptions of sluice gates, floor stands, gate hoists, bench stands, shear gates and flap, mud, gate, check and foot valves, as well as the Columbian fire hydrant.

To obtain a copy of this catalog, mail a Reader Service Card on which is entered the above key number and your name and address.

427

METALLIZING

A recent issue of the **Metco News,** issued by the Metallizing Engineering Co., Long Island City, N.Y., tells the story of how the Bureau of Water at Erie, Penna., started using metallizing in 1930 when they sprayed zinc on all bolts and nuts on a 72-in. dia. 8800 ft. intake. In 1932 a 110,000 gal. wash water tank was metallized with 0.006-in. of pure zinc to stop corrosion.

The bulletin also tells of other uses of metallizing to protect the interior of tanks from corrosion. To obtain a copy of this story, mail a Reader Service Card on which is entered the above key number and your name and address.

428

DUPLEX STRAINER

R-S Products Corp., Philadelphia, Penna., has issued a bulletin on the **R-S Duplex Strainer.** This 4-page bulletin shows the construction of this unit which may be obtained in 4 to 24-inch pipe sizes. It is offered for use to supply clean water for industrial processing and utility purposes.

The bulletin shows the design features and gives a table showing dimensions. The valve which directs the water from one basket to the other can be opened by only 2½ turns.

To obtain a copy of this bulletin, mail a Reader Service Card on which is entered the above key number and your name and address.

429

AIR RELEASE VALVES

Simplex Valve and Meter Co., Philadelphia, Penna., has available an 8-page bulletin on **Simplex Air Release Valves** for water, sewage and industrial use. The bulletin discusses air in water pipe lines, the

Peace of Mind

Operators of Roberts-equipped filtration plants have been telling us for years that our continuing interest in helping them keep their plants at peak efficiency, is a service on which they depend — from incidental replacement parts to million gallon per day additions.

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

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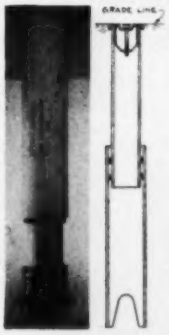

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essential requirements for air release valves and methods of installation of these valves.

A cut-away diagram shows the design and principle of operation, and one section of the bulletin is devoted to special purpose valves for sewage and for gasoline and oil lines, and pump casings.

Mail a Reader Service Card to obtain one of these bulletins. Be sure to enter the above key number and your name and address.

430
STEEL AND ALLOY PLATE

Nooter Corp., St. Louis, Mo., has issued a new catalog on its products, particularly steel and alloy plate fabrication. Titled **Beyond Your Blueprints,** this 16-page catalog shows installation photographs of Nooter tanks and equipment in more than a dozen industries including municipal water and sewage plants. The bulletin also shows the number of Nooter services which the company performs.

Four pages of the bulletin are devoted to corrosion data and show the resistance values of the materials used in fabrication to a wide variety of chemicals.

431
NALCO ABSTRACTS INDEX

National Aluminate Corp., Chicago, Ill., has issued an index for the 1947, 1948 and 1949 issues of the **Nalco Abstracts.** The Nalco Abstracts are issued four times a year and cover current articles on water treatment.

If you wish a copy of this index or desire to have your name put on the mailing list for these Abstracts, use a Reader Service Card on which is entered the above key number and your name and address.

432
STANDARDAIRE BLOWER

The Standard Stoker Co., Inc., New York, N.Y., has released a handy selection chart which lists various capacities possible in the **Standardaire Blower,** when direct connected to standard speed motors. Selection of the proper Standardaire Blower for pressure or corresponding vacuum service will be facilitated by reference to the tables in this bulletin. The bak page of the four page bulletin shows a typical performance chart.

To obtain a copy of this bulletin on blowers, mail a Reader Service Card on which is entered the above key number and your name and address.

433
RUST-OLEUM PROTECTIVE COATINGS

Rust-Oleum Corp., Evanston, Ill., has available a very interesting bulletin and catalog on **Rust-Oleum,** which stops and prevents rust. The bulletin describes Rust-Oleum as the formulation of scientifically processed fish oil with highest grade pigments. Also described is the manner in which this protective coating can be used. Various colors and types of coatings are presented, with information on their applications, resistant qualities, drying time, and thinner used.

To learn more about this protective coating to prevent rust, mail a Reader Service Card on which is entered the above key number and your name and address.

434
LABORATORY FURNITURE

Fisher Scientific Co., Pittsburgh, Pa., has published a bulletin on **Fisher Unitized Laboratory Furniture.** For water and sewage works which are interested in re-equipping old laboratories or setting up laboratories in unused spaces now available, or in constructing new laboratories, this bulletin will be of particular interest because it contains a whole set of illustrations to show the 18 standard pieces of furniture usable in laboratories. A helpful feature of the book is a group of typical layouts for specific uses in restricted areas.

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435

RESIN ZEOLITES ON HYDROGEN CYCLE

Graver Water Conditioning Co., New York City, has issued a reprint of an article by V. J. Calise, Technical Director of the company, on **Operating Experiences with Resin Zeolites on the Hydrogen Cycle.** This paper was presented before the Water Conference of the Engineers Society of Western Penna. It shows tables and charts giving the characteristics of organic zeolites operating in the hydrogen cycle with acid regeneration.

In addition to presenting operating results, the reprint explains the applications of acid-regenerated zeolites, compares sulfonated coal type and resin type zeolites and discusses the various factors involved in establishing conclusions as to the effectiveness of this method of water softening including silica removal.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

436

DEHYDRATED CULTURE MEDIA

Difco Laboratories, Detroit, Mich., has issued a **Difco Manual,** which sets forth information on Dehydrated Culture Media for the Examination of Water, Sewage, Dairy and Food Products.

Laboratories in all water and sewage plants should have a copy of this manual because it not only lists all of the media used for bacterial tests on water and sewage, but it also gives a description of each medium, its development, history, application, and method of preparation.

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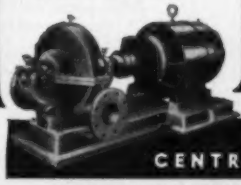

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Aluminum Co. of America 4A
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American Cast Iron Pipe Co. 16A
*Anthracite Equipment Co. 100A
Aurora Pump Co. 103A

B

Bio-Chemical Process, The 98A
Blaw-Knox Co. 81A
Bucyrus-Erie Hydrocrane Div. 15A
*Builders-Providence, Inc. 12A-91A

C

Calgon, Inc. 87A
Carson-Cadillac Corp. 100A
Carter Products Corp. 82A
Carter Co., Ralph B. 103A
Cast Iron Pipe Research Ass'n 10A-11A
Cement Gun Co. 97A
Centriline Corp. 88A
Chapman Valve Mfg. Co. ..... Second Cover
Chicago Bridge & Iron Co. 13A
*Chicago Pump Company 79A
Clark Co., H. W. 83A
Crane Co. 21A

D

Darley & Co., W. S. 102A
Dearborn Chemical Co. 27A
Directory of Engineers 104A-105A-106A
Dixie Tank & Bridge Co. 36A
Dow Chemical Co., The 86A
Dresser Mfg. Division 29A

E

Ebony Paint Mfg. Co. 102A
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G

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Glauber Brass Inc. 80A

H

Haynes Products Co. 102A
Healy-Ruff Company 97A
*Hellige, Inc. 99A
Homelite Corporation, Inc. 22A
Hydraulic Development Corp. 98A

I

Iowa Valve Co. 99A
*Infilco, Incorporated 19A

J

*Jeffrey Mfg. Co. 24A
*Johns-Manville 14A

K

Kennedy Valve Mfg. Co. 89A

L

Layne and Bowler, Inc. 32A
Leadite Company 99A
Leopold Co., Inc., F. B. 100A

M

*M. & H. Valve & Fitting Co. 93A
McWane Cast Iron Pipe Co. 103A
Mueller Company 9A

N

National Clay Pipe Mfrs. Ass'n 18A
Neptune Meter Company 38A
Niagara Alkali Co. ..... Inside Back Cover
Northrop & Co., Inc. 93A
Norwalk Valve Co. 101A

O

*Omega Machine Co. 17A

P

Pacific Flush Tank Company 34A
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R-S Products Corp. 30A

S

Santa Fe Tank & Tower Co. 101A
Sonken-Galamba Corp. 106A
Sparling, R. W. 96A
Speelman Elevated Tank Service 102A

U

*U. S. Pipe & Fdry. Co. 37A

V

Valve & Primer Co. 97A
Verako Products, Inc. 101A

W

Walker Process Equip. Co. 95A
*Wallace & Tiernan Co., Inc. ..... Back Cover
Warren Foundry & Pipe Corp. 92A
Westinghouse Electric Corp. 6A-7A
Wood Company, R. D. 94A

Y

Yeomans Bros. 85A

Z

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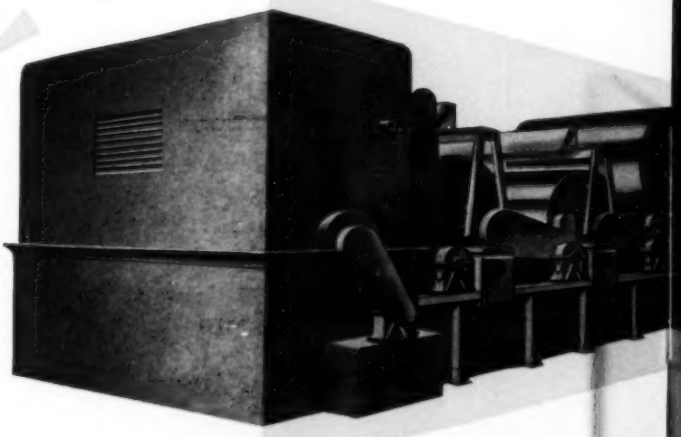

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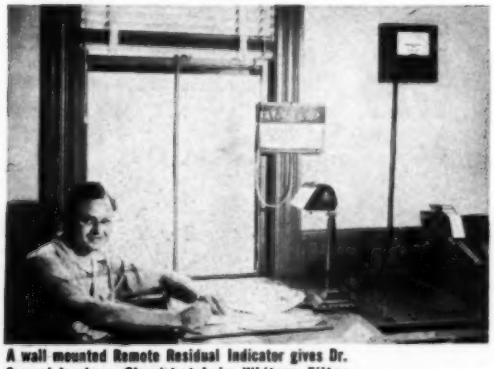
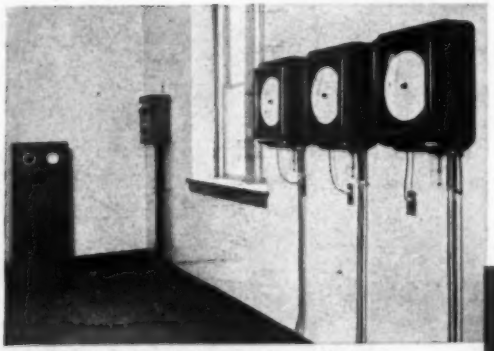
W&T RESIDUAL RECORDER

Aids Chlorination Control at NEW HAVEN Filter Plant



A wall mounted Remote Residual Indicator gives Dr. Samuel Jacobson, Chemist at Lake Whitney Filter Plant, a direct residual reading in his office.

Wallace & Tiernan Residual Chlorine Recorder at Lake Whitney Filter Plant.



Wallace & Tiernan Chlorine Flow Recorders at the Pre-Chlorination Station of the Lake Whitney Filter Plant.

At the Lake Whitney Filter Plant of the New Haven Water Company a W&T Residual Recorder furnishes a *permanent, continuous record* in ppm of the free chlorine residual ahead of the slow sand filters. At any instant the plant operator can read the chlorine residual directly from the Recorder Chart, make any adjustments required, and then check the results by again reading the Recorder—all in a matter of minutes. Thus, changes in the raw water quality or pumping rates can be compensated for immediately, and fast, precision control obtained—the kind of control that helped chlorination to increase filter runs by several months at New Haven and upped filter capacity by as much as 72%.

New Haven's experience, however, gives only one example of the ability of the Recorder. This same instrument is successfully at work in other cities of all sizes. Bellevue, Pennsylvania; Bellingham, Washington; Cleveland, Ohio; Kansas City, Missouri; and Atlanta, Georgia—to name only a few—are all now enjoying the benefits of residual recording.

Find out now from your nearest W&T Representative how the W&T Residual Recorder—by furnishing a permanent record of performance—can bring you such advantages as better chlorination control, improved chlorine usage, and increased operating efficiency.

WALLACE & TIERNAN
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CHLORINE AND CHEMICAL CONTROL EQUIPMENT
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5-49